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NEW GENERIC AND SUBGENERIC NAMES PROPOSED IN THIS VOLUME

LIST OF GENERA AND SUBGENERA

1

ANNALS

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CONTRIBUTIONS TO THE KNOWLEDGE OF SOUTH AFRICAN MARINE MOLLUSCA. PART II. GASTROPODA: PROSOBRANCHIATA: RHACHIGLOSSA*

By K. H. Barnard

(With 52 figures in the text)

RHACHIGLOSSA

Fam. *MARGINELLIDAE*

1917. Tomlin. *Proc. Mal. Soc.*, xii, pp. 242–306 (list of Recent species).
1925. Thiele. *D. Tiefsee Exp.*, xvii, pp. 191–7.
1932. Turton. *Mar. Sh. Port Alfred*, pp. 33–44.

A large number of specimens, fresh and worn, have been retrieved from the P.F. bottom-samples. Most of these have been identified; the remainder may be useful when a thorough study of South African Marginellas is undertaken.

The *Pieter Faure* did not obtain all the species described by Thiele from the *Valdivia* collection.

In this work only those species are mentioned for which additional records extend the hitherto known distribution.

Tomlin (p. 246) credits 43 species to the 'Cape' (South African) region. In later years he added four more species. All of these seem to be well established, though I have suggested (*infra*) that *taylori* renamed *barnardi* is a synonym of *differens*.

Thiele added 12 species, but I cannot admit the validity of all of these.

Turton listed 79 names of 'species and varieties' found by him at Port Alfred. Many of these are obviously additional names applied to known species and juveniles.

About 60 species might be a fair estimate of the number of South African Marginellas.

The size of apparently mature examples of the same species sometimes varies considerably: e.g. *musica* (with fully developed outer lip) from 15 to 25 mm. Tomlin has no comment on this feature, but he mentions that sinistrorsity occurs more frequently in this family than in other marine Gastropods (p. 246). I have not seen one such example, though some species (e.g. *biannulata*) are often found in hundreds in private collections.

* Part I. Toxoglossa: *Ann. S. Afr. Mus.*, vol. xliv, part 4, 1958.

The presence or absence of denticles (plicae) within the outer lip is usually easily seen, but the lip margin is much exposed to wear and often appears smooth. This may explain Smith's statement that the lip is either smooth or minutely denticulate in *dulcis* (= *bensoni*).

The radulae of only two species have been obtained: *capensis* and *biannulata*. There was no difficulty in finding the radulae of these two; but examples of *rosea*, *bairstowi* and *musica* were examined without success. Evidently the radulae of these species are very small and only to be found by a more refined technique than is usually employed. Tomlin (p. 245) quotes Gwatkin as saying that the radula of Marginellas is 'extremely hard to extract' but whether the difficulty is due to minute size is not stated. Fresh material is necessary, as animals long preserved in formalin or alcohol are not easily dissected.

For '*Marginella*' *angustata* Sow. (Smith, 1906, *Ann. Natal Mus.*, i, p. 28), see *Ancilla errorum* Tomlin.

Egg-capsules. Twelve egg-capsules affixed to a *Clavatula tripartita* from 31° 38′ S. 29° 34′ E. (off Port St. Johns), 26 fathoms (U.C.T. 1958).

Nearly hemispherical, maj. and min. diam. 4 and 3, height 2 mm.

Only one protoconch in each capsule. $2\frac{1}{2}$ whorls, alt. 2·5, diam. 2 mm. White, with on the last half or three-quarter whorl a blackish-grey band, more or less broken up into spots, at the suture with previous whorl. Columella pleats 4.

A 45 mm. *nebulosa* Bolten (S. Afr. Mus. no. A6382) has a similar dark stripe on the 1st postnatal whorl, but not on the protoconch (if there was one, it has been obscured by the surface glaze).

The protoconchs of *bicatenata* and *mosaica* also seem to be of a suitable size, but the juveniles (*v. infra*, pp. 5, 6) show no trace of a dark band at the *top* of the whorl near the suture.

M. piperata also is not excluded as a possible parent of these capsules, but no unworn examples are available.

Marginella munda Smith

1904. Smith. *J. Malac.*, xi, p. 31, pl. 2, fig. 14.

Off Illovo River (Natal), 27–30 fathoms, one worn and broken; off Cove Rock (East London area), 22 fathoms, two worn (S. Afr. Mus. P.F. coll.).

Marginella aphanospira Tomlin

1913. Tomlin. *J. Conch.*, xiv, p. 101 text-fig.

The type was described as having two columella pleats. The specimen seen and referred to by Tomlin (p. 102) has 3 pleats. The 3rd pleat can only be seen when the shell is viewed obliquely from below (except in immature examples where it is fully exposed). A Still Bay example has 3 and a feeble 4th pleat.

Port Elizabeth (seen by Tomlin) and Still Bay (S. Afr. Mus.).

Off Umkomaas River (Natal), 40 fathoms, 2; off Sandy Point (north of Cape Morgan), 51 fathoms, 2; off Cape Morgan, 33 fathoms, one; off Hood Point (East London area), 49 fathoms, 2; 34° 5′ S., 25° 55′ E., 67 fathoms, one immature; 34° S. 25° 44′ E., depth ?, 2 (S. Afr. Mus. P.F. coll.).

Marginella capensis Krauss

Fig. 1 (*d*)

1848. Krauss. *Südafrik. Moll.*, p. 25, pl. 6, fig. 21.
1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), pp. 34, 49.

When collected alive the shell is fawn coloured, the sutures marked by a narrow white band, outer lip and anterior portion of the columella white.

Radula with 46–56 rows, the denticles variable and asymmetrical on either side of the median line: see fig. 1*d*.

Seven specimens from 34° 27′ S. 25° 42′ E., 256 fathoms, were identified by Sowerby as this species, although the largest one measures only 9 × 4·3 mm. In shape they resemble *fallax* more than typical *capensis*, but there are only 4 columella pleats and no trace of denticulations within the outer lip. They probably represent another species, but for the present may be recorded here.

Marginella perla Marrat

Fig. 1 (*a*)

1852. Krauss. *Arch. Naturg.*, i, p. 37 (*biplicata*, preocc.).
1876. Marrat. *J. Conch.*, i, p. 136.
1886. Watson. *Challenger Rep.*, xv, p. 267, pl. 16, fig. 8 (*chrysea*).
1903.* Von Martens. *D. Tiefsee Exp.*, vii, pl. 3, fig. 6 (Krauss's type) (not the recorded specimen = *brocktoni*).
1932. Turton. loc. cit., p. 36, pl. 7, no. 272 (*innocens*).

A curious feature of this species is the retention of previous lip varices on the outer surface. This is referred to by Watson, but not shown in his figure. It appears, however, in von Martens's figure of Krauss's type. It occurs in all the specimens I have seen, and may be regarded as a diagnostic character. Sometimes it gives an almost turreted appearance to the spire.

Watson gave the number of columella pleats as 3, but the 3rd (uppermost) is scarcely a pleat: 'only the end of the columella surface before the second pleat' (von Martens).

Sea Point, Cape Town (Watson); St. James (False Bay), and Still Bay (S. Afr. Mus.); Port Elizabeth (Sowerby); Port Alfred (Turton).

* In Part I the date of this paper was quoted as 1904, because it was received at the British Museum Library in February 1904, and was also noticed in *Naturae Novitates* in the same month. I have since found, however, that the original cover of Lief. 1 of vol. vii is dated 1903. Von Martens's paper is also entered in the 1903 Zoological Record.

The exact month of publication of von Martens's paper is sometimes important to decide priority, e.g. *Nassa analogica* Sow., 8 July 1903, *N. circumtexta* von Martens, 18 Dec. 1903.

Marginella lucida Marrat

1877. Marrat. *J. Conch.*, i, p. 205.
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 39, pl. 1, fig. 2 (*turtoni*).

Off Tugela River (Natal-Zululand), 47 fathoms, one; off Illovo River (Natal), 27–30 fathoms, 3; off Umkomaas River (Natal), 40 fathoms, one; off Cape Morgan, 47 fathoms, 4; off East London, 20 fathoms, one; off Cove Rock (East London area), 22 fathoms, 3 (S. Afr. Mus. P.F. coll.). 30° 47′ S. 30° 29′ E., 24 fathoms (U.C.T.).

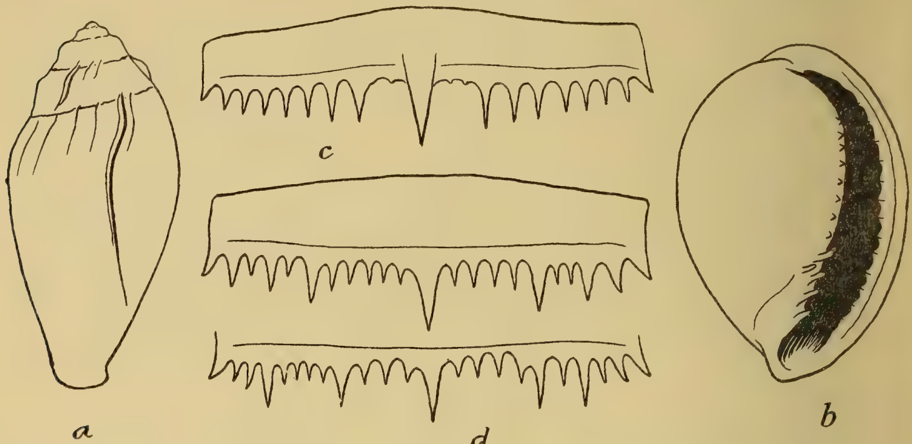


Fig. 1.

(*a*) *Marginella perla* Marrat. (*b*) *M. perminima* Sow. (*c*) radula plate of *M. biannulata* (Fabr.). (*d*) radula plates from two individuals of *M. capensis* Krss. to show variation.

Marginella biannulata (Fabr.)

Fig. 1(*c*)

1826. Fabricius. *K. Dansk. Vid. Selsk. Skr.*, ii, p. 57.
1841. Kiener. *Coq. Viv. Marginella*, p. 41, pl. 13, fig. 4 (*zonata*, preocc.).
1848. Krauss. *Südafrik. Moll.*, p. 126, pl. 6, fig. 22 (*bilineata*).

Radula large for the size of the animal: 1·5 × 0·3 mm. in shell 6 mm. long; 60 rows, median tooth largest, flanked by 8–9 smaller teeth and 1–2 denticles on either side.

Off Tugela River (Natal-Zululand), 47 fathoms, one; off East London, 20 fathoms, 2; off Cove Rock (East London area), 22 fathoms, 2; off Keiskamma Point, 33 fathoms, one (S. Afr. Mus. P.F. coll.).

Marginella adela Thiele

1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 36 (not the fig. = *multizonata* = *cylindrica*).
1925. Thiele. loc. cit., p. 192, pl. 33 (21), fig. 23.

35° 16′ S. 22° 26′ E., 155 metres (Sta. 104, corrected by Thiele, instead of Sta. 114 von Martens).

Off Cape Natal (Durban), 54 fathoms, 3; off Hood Point (East London area), 5; 33° 3′ S. 27° 57′ E., 32 fathoms, 5; 34° 26′ S. 25° 42′ E., 125 fathoms, several; off Cape St. Blaize, 125 fathoms, several (S. Afr. Mus. P.F. coll.).

The above P.F. specimens seem referable to Thiele's species. None of them show the four colour bands distinctly, though in two or three of them there are traces of 1–2 bands.

Marginella musica Hinds

1844. Hinds. *Proc. Zool. Soc. Lond.*, p. 73.
1844. id. *Zool. Voy. Sulphur. Moll.*, p. 44, pl. 13, figs. 8, 9.
1848. Adams & Reeve. *Zool. Voy. Samarang.*, p. 28, pl. 7, figs. 4*a–c*, coloured (*diadochus*).
1886. Watson. *Challenger Rep.*, xv, p. 265.
1903. Smith. *Proc. Mal. Soc.*, v, p. 364 (*diadochus*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 33 (*diadochus*).
1917. Tomlin. loc. cit., p. 263 (*diadochus*) and p. 283 (*musica*).
1925. Thiele. loc. cit., p. 194.

Cream, pale buff or grey, with narrow dark grey spiral lines varying in number on last whorl from 5–13 (on base, i.e. length of aperture, varying from 4–10). Mature examples 15 to 25 mm. long. Foot and mantle pale pink with crimson radiating stripes (Adams & Reeve, fig. 4*a*).

35° 4′ S. 18° 37′ E., 150 fathoms (Watson); 33° 41′ S. 18° E., 178 metres; 34° 33′ S. 18° 21′ E., 318 metres; and 35° 16′ S. 22° 16′ E., 155 metres (von Martens); St. Francis Bay (Thiele).

Off Cape Recife, 56–124 fathoms, Agulhas Bank and around Cape Point to the Saldanha Bay area, 30–230 fathoms, one station in False Bay 14 fathoms (S. Afr. Mus. P.F. coll.).

Living: Simon's Bay (von Martens); False Bay (U.C.T.), 35° S. 20° 49′ E., 91 metres (s.s. *Africana*, per U.C.T.); Saldanha Bay area, 55 and 100 fathoms; off Cape Point 145 and 230 fathoms; and Agulhas Bank, 45 fathoms (P.F. coll.).

Remarks. A characteristic and abundant species.

The largest specimen is 25 × 12·5 mm. (off Cape Point, 85 fathoms); the smallest examples 5 × 3 mm., 4 × 2·5 mm., and 3 × 2 mm.; the two former have resp. $2\frac{1}{2}$ and $2\frac{1}{3}$ whorls, the latter has 2 whorls; all have 4 spiral lines on last whorl.

There are plump and slender forms: 11·5 × 7·5 mm. and 11·5 × 6 mm., 22·5 × 12 mm. and 22·5 × 10·5 mm.; both these slender examples are from the Saldanha Bay area, but not all the examples from that area are slender.

The type locality for *musica* is Cape Blanco, that for *diadochus* is Sunda Strait. Watson said his Cape specimen had the more elongate form of *diadochus*, but united this species with *musica*. Smith was inclined to agree. Thiele regarded the Cape specimens as *musica*. Tomlin listed them as separate species. Dautzenberg (1910, 1912) does not record *musica* from West Africa, but Knudsen does (1956. *Atlantide Rep.*, 4, p. 91, pl. 2, fig. 17).

The West African *eveleighi* Tomlin & Shackleford (1913. *J. Conch.*, xiv, p. 11, pl. 1, figs. 5 and 6) strongly resembles specimens of this species with numerous dark lines, especially Knudsen's figure (1956. *Atlantide Rep.*, 4, p. 84, pl. 3, fig. 2).

Turton's *fulvocincta* may be a synonym, but is more likely to be a variation of *piperata*.

Marginella mosaica Sow.

1846. Sowerby. *Thes. Conch.*, i, p. 381, pl. 75, figs. 58, 59.
1892. id. *Mar. Sh. S. Afr.*, p. 19 (var. *langleyi*).

A juvenile consisting of $2\frac{1}{4}$ whorls, 4 × 2·5 mm., has one series of orange dots above the shoulder, and 5 or 6 series below. It is relatively narrower than the juveniles of *bicatenata*.

Port Elizabeth (Sowerby); Port Alfred (Bartsch, Turton).

Off East London, 43 fathoms, one dead; off Nieca River (S. of East London), 43–50 fathoms, one dead and one juv.; off Stalwart Point (N. of Great Fish Point), 53 fathoms, one dead (S. Afr. Mus. P.F. coll.).

Marginella bicatenata Sow.

1914. Sowerby. *Ann. Mag. Nat. Hist.* (8), xiv, p. 477, pl. 19, fig. 7.
1916. Shackleford. *Ann. S. Afr. Mus.*, xiii, p. 193, text-figs. 1, 2 (*tomlini*).

Creamy-white, body whorl with 2 rows of dark grey spots, one row around the shoulder, and is visible also on the two preceding whorls of the spire, the other row starting from the uppermost columella pleat.

Cape St. Blaize, N. × E.$\frac{1}{2}$E., 68 miles, 105 fathoms (Shackleford); Cape St. Blaize, N. × E., 73 miles, 125 fathoms, one juv.; off Umkomaas River (Natal), 40 fathoms, two juv. (S. Afr. Mus. P.F. coll.).

Remarks. The original locality was given as Goree (West Africa) with a query; but possibly the specimen came from the P.F. collection sent to Sowerby.

The juveniles are 3·3 × 2·5 mm. with 2 whorls, 5 × 3·5 mm. with $2\frac{1}{2}$ whorls, and 5·5 × 3·75 mm. with 3 whorls; apex very blunt, rounded, angle *c.* 100°; body whorl white with the distinctive 2 rows of spots, but faded. The smaller juvenile is from the Natal locality.

A larger specimen, 22 × 11 mm., may be referable to this species. The spire is higher, angle *c.* 60°, and the 4th and 5th whorls are irregularly and shallowly fluted axially. Two rows of very faded spots can just be traced in the same position as in the type of *tomlini*. P.F. coll., but no precise locality (S. Afr. Mus. no. A 8776).

Marginella brocktoni Shackleford

1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 37 (*chrysea*, non Watson; not the fig. = *perla*).
1914. Shackleford. *Ann. S. Afr. Mus.*, xiii, p. 98, 2 text-figs.
1925. Thiele. loc. cit., p. 193 (correction to von Martens).

34° 33′ S. 18° 21′ E., 318 metres (von Martens). Cape Point, N. 50° E., 180 fathoms, two (Shackleford).

The *Pieter Faure* obtained no other examples of this species.

Marginella augusta Thiele

1925. Thiele. loc. cit., p. 193, pl. 33 (21), fig. 28.

35° 11′ S. 23° 2′ E., 500 metres (Thiele). One specimen, 17 × 6·5 mm. (outer lip broken), without precise locality (S. Afr. Mus. P.F. coll.).

Remarks. Thiele's figure shows 4 columella pleats, but in his description he does not reckon the anterior fold of the columella as a pleat.

Very like *brocktoni*, but with 4 columella pleats.

Marginella neglecta Sow.

1846. Sowerby. *Thes. Conch.*, i, p. 390, pl. 76, figs. 135, 136.
1852. Krauss. *Arch. Naturg.*, i, p. 38 (*reevei*).
1853. Gaskoin. *Ann. Mag. Nat. Hist.* (2), xi, p. 359 (*rufula*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, pl. 3, fig. 3 (*reevei*) (not the specimens = *clara*).
1917. Tomlin. loc. cit., p. 283 (*neglecta*), p. 294 (*reevei*), p. 295 (*rufula*).

No specimens definitely referable to this species were obtained by the *Pieter Faure.*

Marginella clara Thiele

1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 35 (not the fig. = *reevei* = *neglecta*).
1925. Thiele. loc. cit., p. 192, pl. 33 (21), figs. 21, 22.

35° 16′ S. 22° 26′ E., 155 metres (von Martens, Thiele).

Very like *neglecta*, or possibly a not fully mature *atractus*.

Marginella bensoni Rve.

1865. Reeve. *Conch. Icon.*, pl. 27, fig. 158.
1904. Smith. *J. Malac.*, xi, p. 32, pl. 2, fig. 20 (*dulcis*).
? 1925. Thiele. loc. cit., p. 195, pl. 33 (21), figs. 35, 36 (*laetitia*).

A faint spiral band below the suture and another on lower part of base (Thiele). Thiele said his species was near *adela*, but smaller. It certainly seems near *bensoni*.

35° 16′ S. 22° 26′ E., 155 metres (Thiele).

P.F. specimens from the following localities seem referable to *bensoni*; they are smaller than Thiele's specimens.

Off Umkomaas River (Natal), 40 fathoms; off Cape Morgan, 47 fathoms; 34° 5′ S. 25° 55′ E., 67 fathoms; False Bay, 22 fathoms (S. Afr. Mus. P.F. coll.).

Marginella differens Smith

1892. Sowerby. *Mar. Sh. S. Afr.*, p. 20 (*bulbosa*, non Reeve).
1904. Smith. *J. Malac.*, xi, p. 32, pl. 2, fig. 19.
1916. Shackleford. *Ann. S. Afr. Mus.*, xiii, p. 194, text-figs. 3, 4 (*taylori*, non Olsson).
1919. Tomlin. *Proc. Mal. Soc.*, xiii, p. 65 (*barnardi*, nom. nov. for *taylori*, preocc.).

The type and cotype of *taylori* in S. Afr. Mus. do not seem distinguishable from other specimens identified by Shackleford as *differens*.

differens forma *eugenes* n.

Shape of *differens*, but larger and slightly less obese. 4 whorls. Columella pleats 4 with traces of 1–4 additional pleats posteriorly. Outer lip not reaching suture above, scarcely shouldered, not varicoid, internally with 18–20 well-developed denticulations or plicae, slightly inflected at upper end, aperture indented anteriorly. 7·5 × 4·8 mm. (Type), another 8 × 5 mm. Uniform pale buff.

Off Cape Natal (Durban), 85 fathoms, one; off Umkomaas River (Natal), 40 fathoms, one; 34° 27′ S. 25° 42′ E., 256 fathoms, 5; 34° 26′ S. 25° 42′ E., 124 fathoms, 6; Gericke Point (Knysna area), 42 fathoms, one; off Cape St. Blaize, 37 fathoms, 2; the same, 125 fathoms, 11; off Cape Infanta, 46 fathoms, one (S. Afr. Mus. P.F. coll.).

Remarks. The 8 × 5 mm. specimen from off Gericke Point was seen by Tomlin and Shackleford, and considered to be a n. sp. but 'too poor' for description. Actually it seems in quite fair condition, though the surface is not glossy. Therefore the glossy, but slightly smaller, specimen from off Umkomaas River is taken as the type (S. Afr. Mus. no. A8786) of this large form.

Only further research will show whether a name is really necessary; the difference in size between this form and normal *differens* (5–8 mm.) is no greater than that found in *musica* (15–25 mm.).

Marginella burnupi Sow.

1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 10, pl. 6, fig. 35.
1929. Dautzenberg. *Faune Col. Franc.*, III, 4, p. 381.
1932. Turton. *Mar. Sh. Port Alfred*, p. 42.
Not Thiele. 1925. loc. cit., p. 192, pl. 33 (21), figs. 24, 25.

Conical, widest slightly above middle, narrowing anteriorly, spire flat. Columella pleats 5 (Sowerby), 6–8 in larger specimen. Outer lip incrassate (when mature), internally plicate. 4 × 2 mm. (Sowerby); 5 × 3 mm.

Port Elizabeth (Sowerby); Port Alfred (Turton).

Algoa Bay, 67 fathoms, one, typical; off Glendower Beacon (Port Alfred area), 66 fathoms, one, with low spire (S. Afr. Mus. P.F. coll.).

Distribution. Madagascar (Dautzenberg *fide* Bavay).

Remarks. Of 4 worn specimens from Port Alfred (coll. Turton) one (immature) has a flat spire, the others have low spires, definite but not so high as in Thiele's figure.

Thiele had difficulty with *burnupi* and *dulcis* (= *bensoni*) owing to variability, and suggested that the plump and slender forms might possibly be the two sexes. Both his figures show rather high spires, quite unlike Sowerby's figure and the typical specimen recorded above; moreover, fig. 24 shows a denticulate lip (which is correct for *burnupi*), but fig. 25 shows a non-denticulate lip. Thiele's specimens came from Algoa Bay, Agulhas Bank, and St. Francis Bay; also from Great Fish Bay (Angola). I doubt whether any of these were really *burnupi*; they should be re-examined, especially the Angolan specimen.

M. almo Bartsch 1915 also has a low spire, but is ovoid in shape with the greatest width in the middle.

Marginella fallax Smith

1903. Smith. *Proc. Mal. Soc.*, v, p. 365, pl. 15, fig. 20.

Off East London, 32 fathoms, two; False Bay, 20 fathoms, 3 (S. Afr. Mus. P.F. coll.).

A worn specimen in S. Afr. Museum is said to have come from 'Natal', but the record is unreliable.

Marginella keenii Marrat

1871. Marrat. *Ann. Mag. Nat. Hist.* (4), vii, p. 141, pl. xi, fig. 13.
1925. Thiele. loc. cit., p. 194, pl. 33 (21), fig. 30 (*agulhasensis*).

35° 16′ S. 22° 26′ E., 155 metres (Thiele).

Cape Point N. 16° E., 10 miles, 85 fathoms, 2; off Glendower Beacon (Port Alfred area), 100 fathoms, one (S. Afr. Mus. P.F. coll.).

Remarks. Not having seen Marrat's original description, I accept Tomlin and Shackleford's identification of the three P.F. specimens. They are clearly the same as Thiele's *agulhasensis*.

The 2 Cape Point specimens (13 × 7 mm.) have 3 columella pleats, one of them with an additional indistinct one as shown in Thiele's figure; the Glendower Beacon specimen has 4 well-defined pleats. The latter is somewhat worn, and hence proportionately broader (11 × 7 mm.).

Marginella shepstonensis Smith

1906. Smith. *Ann. Natal Mus.*, i, p. 31, pl. 7, fig. 5.

Wavy or zigzag brown axial lines, thickened in two or three places so as to form 2 or 3 spiral bands of crescentic marks, one in the middle and one towards each end of the body whorl.

Off Tugela River (Natal-Zululand), 47 fathoms, one; off Illovo River (Natal), 27–30 fathoms, 2; off Umkomaas River (Natal) 40 fathoms, one (S. Afr. Mus. P.F. coll.).

Marginella kerochuta Shackleford

1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 34 (not the fig. = *zeyheri*).
1914. Shackleford. *Ann. S. Afr. Mus.*, xiii, p. 97, 2 text-figs.
1925. Thiele. loc. cit., p. 191 (correction to von Martens).

Biconical, outer lip when mature forming a strongly projecting shoulder, spire (including shoulder) subtending an angle of 70° (type) to 90°. Mature 9 × 6 to 13 × 7 mm. (Thiele: long. 8–11 mm.).

34° 33′ S. 18° 21′ E., 318 metres (von Martens); 35° 16′ S. 22° 26′ E., 155 metres (Thiele).

Off Cape Point, 135 fathoms (Shackleford).

36° 40′ S. 21° 26′ E., 200 fathoms, one fresh; off Cape St. Blaize, 125 fathoms, 6 worn; Brown's Bank (approx. 36½° S. 21° E.), 80–100 fathoms, one fresh, immature (S. Afr. Mus. P.F. coll.).

Remarks. Type and cotype in S. Afr. Mus. The type has the highest spire with angle 70°, the cotype with angle 80°; the specimen from southern end of Agulhas Bank with angle 80°, and the worn specimens with angles 85°–90°.

Closely related to *zeyheri*, but larger and from deeper water.

Marginella zeyheri Krauss

1852. Krauss. *Arch. Naturg.*, i, p. 38.
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 20 (*metcalfei*, non Angas).
1903. Von Martens. *D. Tiefsee Exp.*, vii, pl. 3, fig. 4 (Krauss type) (not the description = *kerochuta*).
1904. Smith. *J. Malac.*, xi, p. 31, pl. 2, fig. 18 (*pura*).
1917. Tomlin. loc. cit., p. 306, and p. 292 (*pura*).
1925. Thiele. loc. cit., p. 191 (correction to von Martens).
1925. id. ibid., p. 195, pl. 33 (21), figs. 33, 34 (*aurelia*).

Biconical, outer lip forming a strongly projecting shoulder, spire angle 70°. Mature: 5 × 3 to 7·5 × 4–4·5 mm.

Port Elizabeth (Sowerby); Port Alfred (Smith, Bartsch, Tomlin).

35° 16′ S. 22° 26′ E., 155 metres; 34° 8′ S. 24° 59′ E., 80 metres (Thiele).

Off Umkomaas River (Natal), 40 fathoms, 2; off Cape Morgan, 47 fathoms, 2; off Cove Rock (East London area), 22 fathoms, 5; off East London, 20 fathoms, 6 (S. Afr. Mus. P.F. coll.).

Remarks. Specimens in which the outer lip is worn smooth have the appearance of belonging to the non-denticulate section of the genus.

Marginella atractus Tomlin

1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 227 (*fusiformis*, non Hinds).
1918. Tomlin. *J. Conch.*, xv, p. 306, pl. 10, fig. 6.
1925. Thiele. loc. cit., p. 195, pl. 33 (21), figs. 31, 32 (*julia*).
1925. id. ibid., p. 195, pl. 34 (22), fig. 1 (*meta*).

Fusiform, outer lip when mature forming a well-marked shoulder, spire angle 50°. 3 × 1·5 mm. (2½ whorls); 4 × 1·75 mm. (3 whorls); mature: 5·5 × 2·5 mm. to 8 × 3·75 mm.

Nanquas Peak (eastern end of Algoa Bay), 49 fathoms (Sowerby); Port Elizabeth (Smith); Port Alfred (Tomlin, Turton); Still Bay (S. Afr. Mus. Muir coll.).

34° 51′ S. 19° 37′ E., 80 metres; 35° 16′ S. 22° 26′ E., 155 metres; 35° 29′ S. 21° 3′ E., 102 metres; and 35° 26′ S. 20° 56′ E., depth ? (Thiele).

Off East London and Cove Rock, 22–32 fathoms; off Keiskamma River and Great Fish Point; Algoa Bay 22–30 fathoms; off Cape Recife, 125 and 256 fathoms; off Cape St. Blaize, 125 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. Judging by the numbers of specimens retrieved from the P.F. bottom-samples, this species seems concentrated chiefly in the East London to Algoa Bay area.

Over 100 examples have been examined. Comparatively few specimens show a definite lip denticulation; often it is traceable only in an oblique light; much depends on the condition of the specimen.

The proportions vary slightly, though the present material does not altogether support Turton's statement that the broader *zeyheri* and narrower *atractus* 'grade together' (beach specimens may do so!); I have found little difficulty in separating them and therefore maintain the two species. On the other hand the slight differences relied upon by Thiele for his species do not seem to justify additional species.

Marginella perminima Sow.

Fig. 1(*b*)

1894. Sowerby. *J. Conch.*, vii, p. 370.
1897. id. *Append. Mar. Sh. S. Afr.*, p. 9, pl. 6, fig. 36.
1932. Turton. loc. cit., p. 43 (referred to under *neptuni*).

Columella pleats 4 plus 7–8 tiny denticles.

Port Elizabeth (Turton).

Off Cape Natal (Durban), 54 fathoms, one; off Umkomaas River (Natal), 40 fathoms, one; off Sandy Point (N. of Cape Morgan), 51 fathoms, 2; off Cove Rock (East London area), 22 fathoms, 2; 33° 3′ S. 27° 27′ E., 32 fathoms, one; 34° 27′ S. 25° 42′ E., 56 fathoms, one; off Cape St. Blaize, 125 fathoms, one (S. Afr. Mus. P.F. coll.).

Remarks. The original description is not available to me. Turton says the species has only 3 columella pleats. In some of the present specimens only 3 are clearly visible, the fourth and the additional denticles being seen only in the best specimens.

Fam. *CANCELLARIIDAE*

1903. Thiele *D. Tiefsee Exp.*, vii, p. 171 (*radula*).
1911. Schepman. *Siboga Exp. monogr.*, xlix, 1, p. 265 (radula) (line 18 for 'nearly' read 'neatly').
1955. Adam & Knudsen. *Bull. Inst. Roy. Sc. Nat. Belge*, xxxi, no. 61, p. 18 (radula).
1958. Barnard. *J. Conch.*, xxiv, p. 243 (radula).

Eight species have been known hitherto from South African waters. In the present paper one new species and one new record are added.

C. dalli Bartsch 1915 is known from a single specimen recorded as coming from the Cape of Good Hope. *C. plebeja* Thiele 1925 is known from two shells from the Agulhas Bank. The *Challenger* species *imbricata* Watson 1882 was rediscovered by the *Pieter Faure*, which also obtained the new species, but no examples of *plebeja*.

The most interesting discovery, however, was made by the Fisheries Survey vessel *Africana* off Lüderitzbucht, viz. a species which seems referable to the Italian Pliocene-Miocene *lyrata*. Specimens identified with this fossil species have already been recorded from off the Cape Verde Islands and the coast of northern Angola, in the latter locality living. The extension southward of the range of this species, indeed its presence in three localities off the west coast of Africa, raises very interesting zoogeographical questions.

In three species I have been able to make some observations on the remarkable radula of the genus *Cancellaria*. Unfortunately the condition of the material left no opportunity of investigating the myology.

The radula consists of a large number (at least 100) of very long slender teeth attached in single file to a basal membrane. The teeth are oriented in two groups: those attached to the shorter anterior portion of the membrane project forwards, the more numerous teeth on the posterior portion project backwards, and appear to be replacers.

The radula is enclosed in a double sheath (Barnard, loc. cit., fig.): a smaller inner one rather like the carapace of a bivalve Crustacean; the outer larger one has a pointed tubular anterior projection with a small apical opening. I have suggested that possibly this buccal apparatus operates by pushing the anterior teeth through the tubular opening of the outer sheath, which would hold the teeth firmly like the hairs in the collar of a paint-brush, and thus using them to sweep particles of food into the mouth. But the myology should be studied, and for this purpose fresh material is necessary.

Cancellaria imbricata Watson

Fig. 2

1882. Watson. *J. Linn. Soc. Lond.*, xvi, p. 325.
1886. id. *Challenger Rep.*, xv, p. 274, pl. 18, fig. 10.
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 230.
1958. Barnard. loc. cit., p. 244.

Protoconch (corroded) smooth, diam. 2 mm. Postnatal whorls 4; 1st with 3 spiral lirae, 2nd and following whorls with 4, crossed on 1st and 2nd, and sometimes part of 3rd whorl by feeble axial ribs, intersections slightly tuberculose. Growth-lines closely imbricate, retractively concave between each pair of spiral lirae. 10–12 additional lirae on base. 29 × 17 mm., a juv. 13 × 8 mm.

Radula with at least 100 extremely long slender filiform teeth set closely together in two divergent series on a narrow basal membrane; apex of each tooth truncate, obscurely denticulate, one of the margins near apex also obscurely denticulate. Length of basal membrane *c.* 1 mm., of each tooth *c.* 2 mm.

Shell dull white; animal (as preserved) greenish.

35° 4′ S. 18° 37′ E., 150 fathoms, green sand (Watson). Off Cape Point, 135–190 fathoms, green sand with black specks (S. Afr. Mus. P.F. coll.).

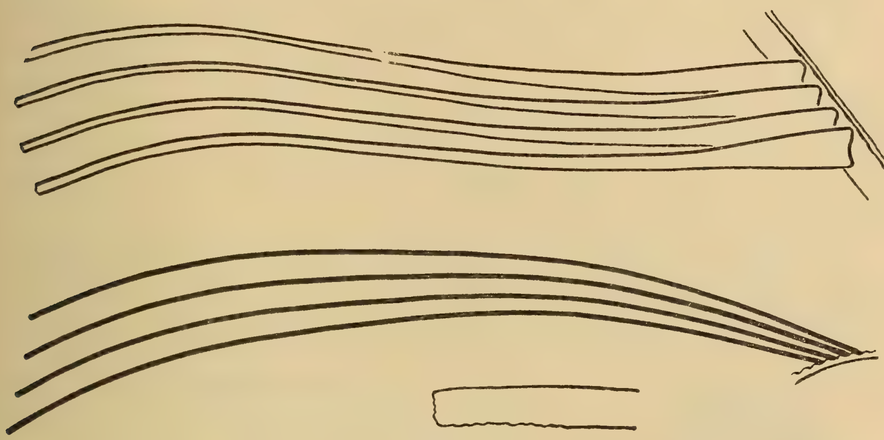


Fig. 2.

Cancellaria imbricata Watson, face (slightly oblique) and lateral views of radula plates on basal membrane, with apex of one plate further enlarged.

Remarks. The *Challenger* obtained one specimen; the *Pieter Faure* 14 specimens (including the one recorded by Sowerby); three were taken alive.

The apex of all the shells, including the juvenile of 13 mm., is more or less corroded.

Although Watson said the aspect of the shell suggested an *Admete*, the presence of a radula shows that he placed the species in the correct genus.

Cancellaria bifasciata Desh.

1859. Chenu. *Man. Conchyl.*, i, p. 277, fig. 1845.

Umbilicus narrowly open. Aperture longer than spire. Whorls rounded, suture deep, but visible laterally. Protoconch 2 whorls, smooth. Postnatal whorls $3\frac{1}{2}$; at first spirally lirate, then growth-lines becoming stronger and forming numerous axial riblets on 2nd and first part of 3rd whorl, producing a cancellate sculpture; but on body whorl becoming again subordinate to the spiral lirae; the latter *c.* 11 on body whorl, with a fine intermediary between each of the upper 3 or 4 pairs of main lirae; *c.* 16 additional lirae on base, very regularly arranged. Columella with 3 pleats. Aperture oval, no canal. 24 × 14 mm.

Pale buff with faint orange patches above and below a pale band slightly below middle of whorl.

Off Cape Natal (Durban), 47 fathoms, one complete; and 54 fathoms, three broken body whorls (S. Afr. Mus. P.F. coll.).

Remarks. The complete specimen described above was identified by Tomlin as *bifasciata* var., with the suggestion that further examples might show it to be a distinct species. As far as can be judged, it is exactly like Chenu's figure. It also corresponds with a figure of *elegans* Sow. (Reeve. *Conch. Icon.*, x, pl. 16, fig. 75) in Gravely (1942. *Bull. Madras Govt. Mus.*, n. s., V, 2, p. 68 (in key), fig. 12 *i*).

The broken body whorls agree in sculpture with the above described specimen.

Cancellaria euetrios n. sp.
Fig. 3

Umbilicus narrowly open. Aperture a little longer than spire. Whorls convex, without shoulder, suture deep, not quite visible in lateral view. Protoconch $1\frac{1}{2}$ whorls, alt. 0·5 mm., diam 0·75 mm., smooth. Postnatal whorls 2, junction with protoconch not clearly defined but marked by 4–5 indistinct and incomplete axial ribs; 28 ribs on 1st, 30 on 2nd whorl; crossed by spiral lirae 9–10 on 1st, 11 on 2nd whorl, 11–12 additional lirae on base. Columella with 3 indistinct pleats. 4·5 × 2·5 mm.

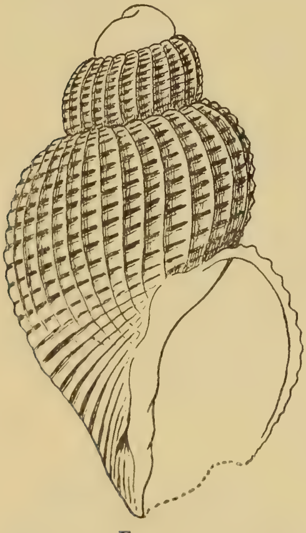


Fig. 3.
Cancellaria euetrios n. sp.

White beneath pale buff periostracum, protoconch white.

34° 26′ S. 25° 42′ E. (off Cape Recife), 124 fathoms, one (S. Afr. Mus. no. A8747. P.F. coll.).

Remarks. The size of the protoconch indicates a small species, but this specimen is probably not fully grown. The cancellate sculpture is very regular ('well-woven') though perhaps not more so than in some other species; the ribs are more prominent than the lirae.

Cancellaria producta Sow.

1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 220, pl. 4, fig. 5.

Off Umhloti River (Natal), 40 fathoms, 2 specimens (Sowerby). Same locality, 2 and one broken; off Umhlanga River (Natal), 22–26 fathoms, one (S. Afr. Mus. P.F. coll.).

Remarks. One of the two type specimens, agreeing with Sowerby's measurements, is in S. Afr. Museum; the other 'type' was probably in coll. Sowerby (? now Brit. Mus.).

Another specimen is broken and bored by *Cliona*, only the last 2½ whorls remaining; it was a larger shell than the type: width 8 mm., with presumably long. *c.* 19 mm.

Cancellaria lamellosa Hinds

1843. Hinds. *Proc. Zool. Soc. Lond.*, p. 49.
1844. id. *Zool. Sulphur. Moll.*, p. 43, pl. 12, figs. 15, 16.
1911. Schepman. *Siboga Exp. monogr.*, xlix, p. 264.
1958. Barnard. loc. cit., p. 244.

Pale buff, a pinky-brown band at shoulder and another about in middle of body whorl, more distinctly visible inside the aperture. One of Burnup's Durban specimens is orange-brown, the bands visible only inside the aperture. The Delagoa Bay shell is very pale pink, with a few brown specks on the crest of each axial rib. Up to 18 × 13 mm. Animal (as preserved) flesh tint.

Radula similar to that of *imbricata*.

Agulhas Bank (Hinds). Off Umvoti, Umhloti, and Umhlanga Rivers (Natal), 22–40 fathoms (S. Afr. Mus. P.F. coll.). Durban (S. Afr. Mus. coll. Burnup).

Living: Delagoa Bay (U.W.).

Distribution. Ceylon, Straits of Malacca, East Indies.

Remarks. The largest specimen (as above) is from Delagoa Bay. The extent to which the umbilicus is covered by the columella callus is variable; and also depends on the angle from which the shell is viewed. This explains the words 'umbilico magno' in Hinds's description.

In Gravely (1942. *Bull. Madras Govt. Mus.*, n. s., V, 2, p. 68 (in key)) *lamellosa* is regarded as one of the varieties of *crispa* Sow.

Cancellaria foveolata Sow.

1848. Sowerby. *Thes. Conch.*, i, pl. 93, figs. 30, 31.
1932. Turton. *Mar. Sh. Port Alfred*, p. 30, pl. 6, no. 224.

Pale buff or amber to chestnut-brown, sometimes irregularly infuscate or with a brown band in middle of body whorl, brown spiral bands often visible inside aperture, protoconch white. 24 × 14 mm.

Natal to Jeffreys Bay (S. Afr. Mus.).

Remarks. Not taken by the *Pieter Faure*, and known only from beach material.

Cancellaria semidisjuncta Sow.

1848. Sowerby. *Proc. Zool. Soc. Lond.*, p. 137; and *Thes. Conch.*, i, pl. 95, figs. 62, 63.

18 × 14 mm.; width of a larger specimen 18 mm., apex broken but full length probably *c.* 25 mm.

East London to Jeffreys Bay (S. Afr. Mus.).

Remarks. Not taken by the *Pieter Faure.* A specimen in S. Afr. Mus., said to have come from Tanganyika, is very worn and has the coarse cancellate appearance of worn South African examples. Sowerby in his original description gave Philippine Islands as the locality, but Bartsch 1915 doubted this locality.

Cancellaria cf. *lyrata* (Brocchi)

Fig. 4

1814. Brocchi. *Conch. foss. subapenn.*, ii, p. 311, pl. 3, fig. 6 (*Voluta l.*) (quoted from D. & F.).
1820. Borson. *Mem. R. Ac. Sc. Torino*, xxv, p. 210 (quoted from Sherborn. Index Anim.).
1894. Sacco. *Moll. Terz.*, part 16, p. 59, pl. 3, figs. 57–65 (*Sveltia l.*) (quoted from D. & F.).
1906. Dautzenberg & Fischer. *Res. Sci. Camp. Monaco*, fasc. 32, p. 17, pl. 1, figs. 11–13 (Recent), figs. 14–16 (fossil).
1955. Adam & Knudsen. *Bull. Inst. Roy. Sc. nat. Belge*, xxxi, no. 61, p. 16, pl. 2, figs. 6, 7, and text-fig.
1958. Barnard. *J. Conch.*, xxiv, p. 243 (radula).

Specimen A.

Aperture very little longer than spire. Protoconch tip broken, remainder slightly corroded, diam. 1 mm. Postnatal whorls 5, profile of 2nd and 3rd slightly angular, of 4th and 5th sharply keeled in middle; 1st whorl corroded, 2nd partly corroded but with indications of 9 or 10 (possibly 11) axial ribs, 3rd with 12, 4th with 11, 5th with 9 ribs, from suture to suture and extending across base; ribs narrow, sharp, with acute points at intersections with the peripheral keel; crossed by spiral lirae, corroded on early whorls, at least a dozen fine and equal-sized above periphery on 4th and 5th whorls, below periphery 2 stronger main lirae and 2 weaker, with finer intermediaries; 6–7 additional lirae with intermediaries on base (total about 15); the main lirae form little prickles at intersections with the ribs. Columella with 3 pleats, columellar glaze not fully developed, thin and not obscuring the ribs and lirae on base. Umbilicus closed. Aperture wide, outer lip thin, not constricted below; canal short and wide. 35 × 24 mm. (incl. peripheral points, 19 mm. excl. these points).

Greyish-white, aperture yellowish-fawn.

Locality? (see Remarks, *infra*) (S. Afr. Mus. ex coll. P. Ross-Frames).

Specimen B.

Aperture a little longer than spire. Apex corroded. Remaining postnatal whorls 4, profile angular, last whorl with peripheral keel. Early whorls corroded, axial ribs 11 on each of the upper two whorls, 9 on last whorl, more or less tubercular at shoulder, but corroded; crossed on last whorl by spiral lirae (not traceable on preceding whorls), at least a dozen fine and equal-sized lirae above shoulder, and about a dozen below, 3 or 4 slightly stronger than the others, about 15 (partly corroded) additional lirae on base, varying in size.

Columella with 3 pleats, columellar glaze extensive, rather thick, the axial ribs and some of the lirae only indicated. Umbilicus closed. Aperture wide, outer lip thin, not constricted below; canal short and wide. 43 × 24 mm.

Dirty brownish-grey, aperture yellowish-brown, glaze whitish.

Radula and sheath: see Barnard, loc. cit., and remarks under genus.

26° 26′ S. 14° 39′ E., 174 metres (off Lüderitzbucht, South West Africa) (s.s. *Africana*, 1948, AFR. 1260 B. per U.C.T.).

Distribution (recent). Off Cape Verde Islands, 628 metres (Dautzenberg & Fischer); 5° 46′–6° 29′ S. 11° 32′–11° 38′ E., 145–230 metres (Adam & Knudsen).

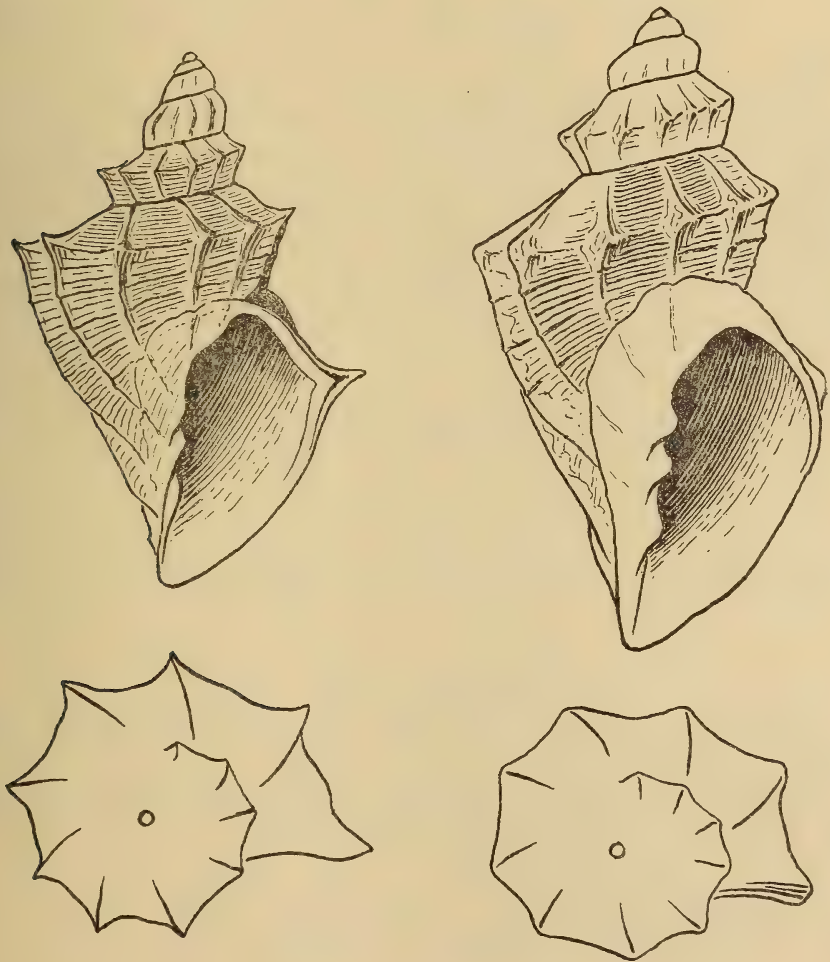


Fig. 4.

Cancellaria cf. *lyrata* (Brocchi). Specimen A on left, B on right; with diagrammatic apical views of last whorl.

Remarks. Unfortunately the provenance of the less corroded Ross-Frames specimen (A) is unknown. The late P. Ross-Frames collected many shells while serving in the military campaign in South West Africa in 1914–15 (cf. Burnup. 1923. *Ann. Natal Mus.*, V, p. 2), and in view of the larger living example (B) having been dredged off Lüderitzbucht, it is a reasonable assumption that he obtained his specimen, directly or through a friend, from somewhere in the same area.

The two specimens are obviously conspecific. The Ross-Frames specimen is the less corroded, and is much fresher-looking. It is slightly smaller, and the columellar glaze has not reached its full extent or thickness. It shows, however, that the remaining whorls on the rather badly corroded *Africana* specimen are actually the 1st to 5th postnatal whorls, not a corroded protoconch plus 4 whorls.

There is a striking resemblance between these shells, especially the *Africana* one, and the shell dredged off the Cape Verde Islands, which Dautzenberg & Fischer identified with the Italian Pliocene-Miocene *lyrata*. There is an even greater, in fact an exact resemblance to the specimens described and figured by Adam & Knudsen from off the northern part of the Angolan coast, and likewise referred to the same fossil species.

The fewer and more widely spaced axial ribs on the last whorl in both specimens A and B should be borne in mind in deciding the status, specific or variational, of the South West African form. The fossil form is known to be variable.

Cancellaria lyrata Ad. & Rve. (1850. *Zool. Samarang. Moll.*, p. 42) is probably not the same as *lyrata* (Brocchi), and if so requires renaming.

Fam. *VOLUTIDAE*

1901. Smith. *Proc. Mal. Soc.*, iv, p. 231 (synopsis of S. African species).
1922. Cooke. ibid., xv, p. 6 (radulae).

Gen. Voluta Linn.

Operculum present or absent. Columella with pleats. Radula with tricuspid central tooth only.

Of the five endemic South African species, the radulae of three are known, and one is definitely known to possess an operculum.

Spire high, pointed. With axial ribs.
 Columella callus black . . . . *africana*
 Callus not black.
  Pleats 3 plus 3 obscure ones . . . . *ponsonbyi*
  Pleats 5 . . . . *queketti*
Spire low, blunt. No axial ribs.
 Pleats 2 . . . . *bullata*
 Pleats 4 . . . . *pringlei*

V. mitraeformis, *V. scapha*, and *Melo armata* were not admitted to the fauna-list by Smith (1901). I would also exclude *V. festiva*; if the young specimen recorded by Sowerby (1897) was really found on the Natal coast, it was far more probably an *africana* or a *ponsonbyi*.

Voluta africana Rve.

1856. Reeve. *Proc. Zool. Soc. Lond.*, p. 2, pl. 33, figs, 3, 4.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 31.
1913. Bullen Newton. *Rec. Albany Mus.*, ii, p. 342, pl. 24, figs, 1,2.
1922. Cooke. loc. cit., pp. 7, 10, fig. 3 (radula).
1932. Turton. *Mar. Sh. Port Alfred*, p. 44 and vars. *beckeri*, *ponderosa*, pl. 9, no. 327 (juv.), no. 328, and pl. 10, no. 329.
1933. id. *J. Conch.*, xix, p. 370 (*rietensis*, nom. nov. pro *ponderosa*, preocc.).

Spire high, pointed. Aperture $1\frac{2}{3}$–$1\frac{3}{4}$ times spire. Protoconch $2\frac{1}{2}$ whorls, diam. 4–4·5 mm. (3·5 mm. on an old worn specimen). Postnatal whorls 3. Axial ribs strongly tuberculate at shoulder (but usually abraded), extending below to base in juveniles (up to 16 mm.) but in large specimens becoming obsolete (except in vars. *beckeri* and *rietensis*), 16–18 on 1st whorl, 9–11–13 (sometimes 14) on last whorl; spiral striae over whole whorl, but usually obsolete on body whorl except in fresh specimens. Columella pleats 5, the upper 2 obscure. Outer lip in adult slightly thickened and ascending towards shoulder of preceding whorl. A well-marked columella callus. 67 × 39 mm.

An operculum 'presumably belonging' to a specimen of this species was described by Smith.

Pinky-brown, more or less speckled, speckles usually aggregated to form two more or less solid spiral bands, sometimes with large brown blotches; dark brown spiral lines may appear towards outer lip, but usually they are only visible on the thickened lip where they occur in pairs, threes, or fours; columella callus dark chestnut-brown (Smith: 'coal-black'). Juveniles with 4–5 narrow spiral bands on 1st whorl (or first and a half), continuous or broken into a series of spots (cf. Turton's fig. 327).

Radula with *c.* 54 rows (Cooke).

Fossil: Mio-Pliocene: Redhouse near Port Elizabeth (Newton).

East Africa (Reeve); South-east Africa (Sowerby); Port Elizabeth (Sowerby); Port Alfred (Bartsch, Turton); Port St. Johns and Pondoland (Smith); off Durban, 40 fathoms (Smith); 35° 16′ S. 22° 26′ E., 155 metres, fragmentary lower half, 38 mm. long (von Martens). Natal, from fish stomachs, with var. *beckeri*; Port Alfred, juveniles and var. *rietensis* (S. Afr. Mus.).

Not taken by the *Pieter Faure*.

var. *beckeri* (Shackleford ined.) Turton. A narrow form with usually more numerous ribs (14) which extend to base, sometimes 2 ribs concurrent into one tubercle (e.g. 14 ribs, 10 tubercles), tubercles less prominent. Occurs in Natal along with the plump form.

var. *rietensis* Turton. A thicker-shelled, heavier form, with ribs extending to base. Maybe these shells are merely aged individuals. 68 × 45 mm. (badly

worn), 73 × 46 (apex and canal worn) (S. Afr. Mus.). Recorded only from Port Alfred.

Remarks. If the operculum described by Smith really belonged to this species, the species cannot be placed in the subgen. *Alcithoe.*

Both plump and slender forms occur: 38 × 21, 51 × 27, 52 × 27, 64 × 35, 64 × 37, 65 × 35, 67 × 39 mm.

S. Afr. Mus. has protoconchs and juveniles up to 16 mm., but no specimens between 16 and 38 mm. long.

Specimens with thickened outer lip (with dark lines) 38 and 42 mm. long.

Voluta ponsonbyi Smith

1901. Smith. loc. cit., p. 231, text-fig.
1922. Cooke. loc. cit., pp. 7, 10, fig. 4 (radula).

Spire high, pointed. Aperture $1\frac{1}{2}$–$1\frac{3}{4}$ times spire. Protoconch $2\frac{1}{2}$ (3) whorls, diam. 2–2·5 mm. Postnatal whorls 4. Axial ribs sharply pointed at the shoulder producing a coronate appearance, extending only a short distance towards base on body whorl, 17–20 (22) on 1st whorl, decreasing to 10–14 on last whorl; on 1st whorl spiral striae on upper part and in the intervals between the ribs (if unworn extending across the ribs), on later whorls visible only on upper part (shoulder to suture). Columella with 6 pleats, the upper 3 obscure. Outer lip in adult thickened and ascending towards shoulder of previous whorl. A well-marked columella callus. 83 × 39 mm., others 74 × 36, 78 × 42 mm.

Operculum?

Salmon coloured, with white spiral bands, 7 between shoulder and base on body whorl, crossed by darker lines, two of the broader intervening salmon bands with brighter salmon or orange-brown patches, sometimes somewhat irregular; a dark spot on front of each tubercle; columella and interior of outer lip pinkish, callus white.

Radula with *c.* 53 rows (Cooke).

Off Durban, 40 fathoms (Smith). Natal coast, from fish stomachs. (S. Afr. Mus.). Not taken by the *Pieter Faure.*

Remarks. Smith gave the distinctive differences between this species and *festiva*, size being one of them; but he omitted the sizes of the respective protoconchs. Comparisons as regards size are risky. Smith did not give the size of *festiva*, but said *ponsonbyi* was the smaller species. His specimen with thickened outer lip, therefore presumably mature, was 57 mm. long (there is an exactly similar sized one in S. Afr. Mus., also with thickened lip); but this is greatly exceeded by several specimens in S. Afr. Mus., viz. (with thickened lip and more or less developed callus) 54 (2 specimens), 57, 59, 60, 64, 65 (2 specimens), 74, 78 and 83 mm.

There is a tendency in some specimens for the tubercles to become obsolete on the later part of last whorl; in one specimen the tubercles cease abruptly (only 9 instead of 11 or 12), and the profile of this part of the whorl is evenly curved with scarcely any shoulder.

The dimensions of the 3 largest specimens show that there are plump and slender individuals.

Has been taken only from fish stomachs.

Voluta queketti Smith

Fig. 5

1901. Smith. loc. cit., p. 234, text-fig.
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 226.
1922. Cooke. loc. cit., pp. 7, 10, fig. 6 (radula).

Spire pointed, aperture $1\frac{1}{2}$–$1\frac{3}{4}$ times spire. Protoconch $2\frac{1}{2}$ whorls, diam. 1·75–2 mm. Postnatal whorls 5. Axial ribs 19–21 on 1st whorl, decreasing to 11–14 on last whorl, extending from suture to suture and $\frac{2}{3}$ towards base on body whorl, sharp, especially in juvenile, at top forming projecting points (especially sharp in juvenile), subcoronate and concealing the sunken suture, but rounded off on the last whorl leaving the suture exposed; numerous close-set spiral striae over whole whorl, becoming more widely separated on base, especially well marked at the tops of the ribs in juvenile. Columella pleats 6 (or 7), the upper one or two feeble, in the largest specimen 6 distinct pleats. Outer lip in largest specimen somewhat exsert, sharp edged. 51×22 mm.

Operculum narrow-oval, $11 \times 4{\cdot}25$ mm. in aperture 30 mm. of 51 mm. shell, nucleus a little distance from apex and nearer the outer than the inner margin.

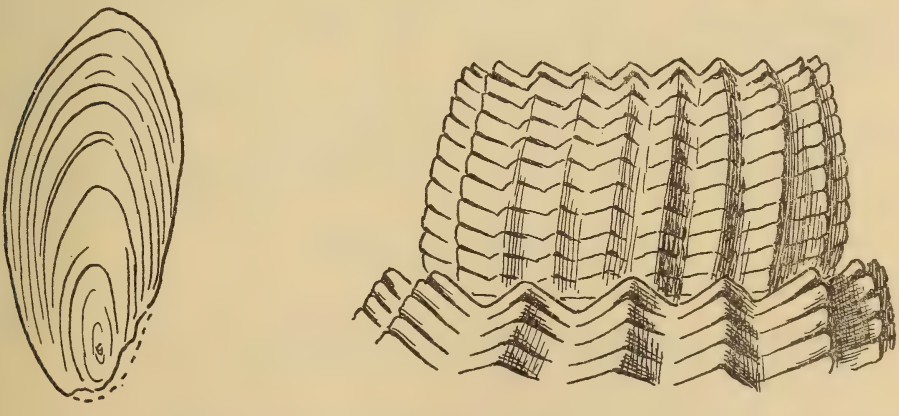


Fig. 5.
Voluta queketti Smith. Operculum of 51 mm. shell. Second and upper part of 3rd whorl of 16 mm. juvenile.

Pale yellowish flesh-tint (Smith) with bright red blotches on upper ends of ribs, an irregular interrupted red band above middle of body whorl and some spots on lower part. Smith's description applies to the present specimens. The largest one, taken alive, has the internal margin of outer lip pinkish, columella white; operculum horn colour.

Radula with *c.* 41 rows (Cooke).

Off Durban, 40 fathoms (Smith); off Cape Natal (Durban), 27 [*sic* = 55] fathoms; off O'Neil Peak (Zululand), 90 fathoms; off Umhloti River (Natal), 27 [*sic* = 54] fathoms (Sowerby).

Off Umhloti River (Natal), 40 fathoms, one living; off Cape Natal, 54–55 fathoms, 7 dead (one 36 mm. long, 4 juv. and 4 broken); off O'Neil Peak, 55 fathoms, one dead (34 mm. long) and one broken (S. Afr. Mus. P.F. coll.).

Remarks. Plump and slender forms occur: 37 × 17 (Smith's type), 36 × 19 and 34 × 15 mm. (S. Afr. Mus.). S. Afr. Mus. has juveniles 14 mm. (protoconch incomplete) to 20 mm. long.

Smith had one specimen; Sowerby returned 7 P.F. specimens, now in S. Afr. Mus., but apparently retained the O'Neil Peak specimen from 90 fathoms (unless the depth is wrongly recorded, as in his other two records). No record is available of how many specimens were sent to Sowerby by Dr. Gilchrist. Probably it is correct to say that less than a dozen complete specimens are known (unless some have since been obtained by private collectors).

Tomlin and Shackleford, to whom two juveniles were submitted some years ago, remarked on their 'extreme likeness to some of the forms from the Barton Beds and the Paris basin'; in fact they doubted whether the shells were really South African!

Smith stated that the Mauritian *delessertiana* has at least 15 columella pleats, but, as in the case of *ponsonbyi*, made the risky statement that *queketti* was a smaller species, and again without giving the dimensions of the protoconchs. The largest known specimen is 14 mm. longer than the type, and may be more comparable with *delessertiana* in size.

The 51 mm. specimen fortunately retains the operculum, showing that this species is correctly assigned to the subgenus *Lyria*. When the animal was removed is not known.

Named after Mr. Quekett, then curator of the Durban Museum.

Voluta bullata Swainson

Fig. 6

1829. Swainson. *Zool. Illustr.*, ser. 2, vol. i, pl. 15 (Voluta, pl. 1.).
1859. Chenu. *Man. Conchyl.*, i, fig. 956.
1901. Smith. loc. cit., p. 234.

Spire low, blunt; aperture 4 times spire (profile from suture to apex; 5–6 times if true vertical height measured), occasionally 4½ or even 5 times. Protoconch 1 (1½) whorls, diam. 4 mm. Postnatal whorls 3 (3½); smooth, without

ribs, shoulder, or spiral striae, except some spiral grooves on lower half of body whorl. Columella pleats 2, with an obscure third one above; a narrow parietal callus in the posterior angle of the aperture. 62 × 30 mm.

Operculum and radula unknown.

Pale brown with darker speckling and irregular marks which form three faint spiral bands, towards the outer lip spiral lines in pairs or threes: juveniles (16 mm.) with dark spiral line dotted with white. The 1st whorl has a 'necklace' of alternating brown and white spots at the suture. Callus dark chestnut-brown.

Port Elizabeth (Sowerby); Algoa Bay (Reeve); Port Alfred (Bartsch, Turton).

FIG. 6.

Voluta bullata Swainson. Slightly oblique apical views of protoconch of 16 mm. shell (*left*) and 29 mm. shell (*right*).

Port Elizabeth and Algoa Bay, St. Francis Bay (= Jeffreys Bay), Still Bay; all dead and more or less worn (S. Afr. Mus.).

Not taken by the *Valdivia* or the *Pieter Faure*. No record of a living specimen, though dead shells are fairly common.

Remarks. The smallest specimen in S. Afr. Mus. is 16 mm. long. Measurements of other (selected) specimens are: 55 × 27, 56 × 29, 57 × 25, 60 × 29, 62 × 29, 62 × 30.

The colour of the parietal callus seems to fade more rapidly than the external markings of the shell, although not so exposed to abrasion.

Type in the British Museum.

Subgen. *Afrivoluta* Tomlin

1947. Tomlin. *J. Conch.*, xxii, p. 244.

Four strong columella pleats. Operculum and animal unknown.*

Proposed by Tomlin as a genus, but here treated as subgenus.

* In an American dealer's catalogue (1957) this species was illustrated, and a specimen 'Taken alive and perfect' was offered for sale. Presumably the animal was extracted and thrown away.

Voluta (*Afrivoluta*) *pringlei* Tomlin

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 199, pl. 34 (22), fig. 18 (*Voluta* sp.).
1947. Tomlin. loc. cit., p. 245, text-fig.

Spire low, blunt; aperture $3\frac{1}{2}$ (juv.) to nearly 3 (adult) times spire. Protoconch 2 whorls, diam. 7·5–8 mm. Postnatal whorls 3; smooth, with fine lines of growth, very fine spiral striae in the type, but none visible in the S. Afr. Mus. adult or juveniles. A flat sutural band of callus adnate to the previous whorl, with irregular upper margin, on body whorl expanding into the large oval or subcircular parietal callus (*c.* 30 mm. diam.) extending from upper suture on body whorl to below the posterior end of aperture; this callus is the easiest means of distinguishing the start of the 1st postnatal whorl from the protoconch. Columella pleats 4, very prominent; columella projecting slightly below base of aperture. Outer lip in adult slightly exsert, and reflexed in lower half $4\frac{1}{4} \times 1\frac{1}{2}$ in. (*c.* 110 × 40 mm.) (Tomlin); $4\frac{3}{4} \times 1\frac{7}{10}$ in. (120 × 45 mm. (S. Afr. Mus.); juveniles 34–35 × 15–16 mm. (S. Afr. Mus.).

Chestnut-brown with 2 broad bands of pale reddish brown on body whorl, sutural edging white, columella pleats red, interior rusty reddish-brown, callus reddish (Tomlin). The S. Afr. Mus. adult is similar, but the general colour, including columellar pleats and aperture is orange-salmon, the bands faintly whitish, callus white.

35° 11′ S. 23° 2′ E., 500 metres (Thiele); SE. of Cape Recife, 120 fathoms, and off Jeffreys Bay (St. Francis Bay), west of Cape Recife (Tomlin).

Off Glendower Beacon (Port Alfred area), 100 fathoms; 34° 27′ S. 25° 42′ E., 250 fathoms; and off Cape St. Francis, 75 fathoms; one juvenile from each station (S. Afr. Mus. P.F. coll.).

The *Valdivia* locality is farther west on the Agulhas Bank than the other localities. The single broken specimen came up in the same haul with a living *Neptuneopsis gilchristi*; it measured 62 × 24 mm., but owing to its fragmentary condition Thiele refrained from naming it.

The *Pieter Faure* obtained only the three juveniles recorded above.

Remarks. As Tomlin said this is the most noteworthy South African shell discovered since the Cape Government trawler *Pieter Faure* obtained *Neptuneopsis gilchristi* in 1897; but he forgot *Pleurotomaria africana* which was discovered by the Fisheries Survey vessel *Africana* in 1931 but not described and named until 1948.

Gen. Volutocorbis Dall

1890. Dall. *Trans. Wagner Free Inst.*, iii, p. 74 (type † *limopsis* Conrad).
1929. Thiele. *Handbuch Syst. Weicht.*, i, p. 344 (s.s. type *abyssicola*).

Operculum absent. Columella with pleats. Radula with tricuspid central tooth, and a transversely oblong, unicuspid lateral tooth.

Remarks. See Sowerby (loc. cit. *infra*). Dall included fossil and Recent species, but Thiele restricted the genus to contain two Recent species only. Allied to the fossil *Volutilithes* Swainson 1840 (type † *spinosa* Lam.).

Volutocorbis abyssicola (Ad. & Rve.)

Figs. 7(*a*), 9(*a*)

1848. Adams & Reeve. *Zool. Samarang. Moll.*, p. 25, pl. 7, fig. 6, juv. (*Voluta a.*).
1886. Watson. *Rep. Challenger*, xv, p. 258, pl. 15, fig. 1, adult (*Voluta a.*).
1889. Studer. *Forschungsreise Gazelle*, iii, pp. 52, 55.
1900. Woodward. *Proc. Mal. Soc.*, iv, p. 121, pl. 10, figs. 4–8, 10, 12 (anatomy).
1901. Smith. loc. cit., p. 235 (*Volutilithes a.*).
1902. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 97, pl. 2, fig. 6 (radula) (anatomy) (*Volutilithes a.*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 31 (*Ternivoluta a.*).
1903. Thiele. ibid., p. 170; pl. 9 (4), fig. 65 (radula).
1922. Cooke. loc. cit., p. 7 (radula).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 200.

Numerous fine axial ribs and spiral lirae forming a cancellate sculpture, with sharp points at the intersections, the first spiral lira with its points forming a narrow shoulder but not concealing the suture; intervals between 1st and 2nd lirae (sometimes between 2nd and 3rd) greater than intervals between the following lirae, forming a shallow groove a little distance below the suture; axial ribs 18–21 on 1st whorl, increasing to 60 or 70 (80 in largest specimen) on body whorl. Aperture $2\frac{4}{5}$ (juv. 14 mm.) decreasing to $2\frac{1}{3}$ or 2 times spire. Protoconch 2 ($2\frac{1}{2}$) whorls, diam. 2 mm. Postnatal whorls 5. Columella pleats 1 in protoconch, 2 in 1st whorl, increasing to 10–12 in adult, but very variable in adults, some pleats being smaller intermediaries between pairs of larger pleats, being as Thiele stated (1925, p. 200) the spiral lirae of the previous whorl overlaid by callus; he regards only the 4 lowermost as true columella

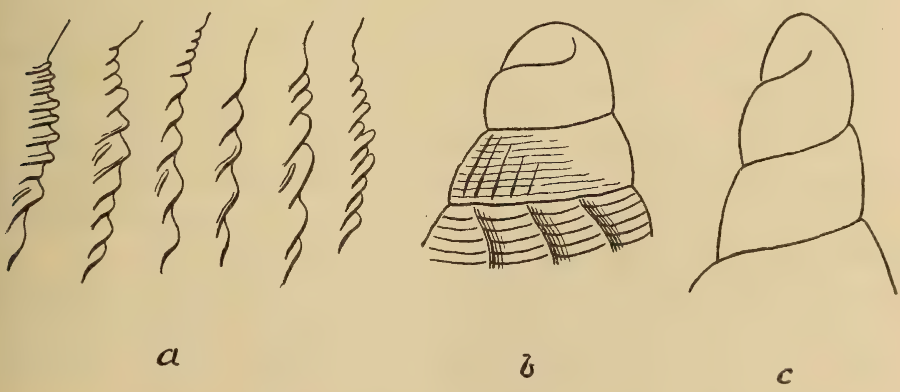


FIG. 7.

(*a*) *Volutocorbis abyssicola* (Ad. & Rve.) variation in columella pleats in adults. (*b*) *Fusivoluta pyrrhostoma* (Watson) protoconch of typical form. (*c*) worn protoconch of forma *major.*

pleats. From the columella a thin parietal glaze extends over base, not concealing the underlying sculpture, its edge adnate to the shell but sometimes with a very slight free edge at the end of the rostrum. Outer lip in adult slightly exsert, margin denticulate, internally plicate. $3\frac{4}{5} \times 1\frac{1}{2}$ in. (96 × 38 mm.) (Watson). A specimen in S. Afr. Mus. has same width and was probably of equal length (protoconch and end of canal broken). 97 × 40 mm. (in a private collection).

Smallest specimen in S. Afr. Mus. 11·5 × 6 mm., protoconch plus 2 whorls. Smallest specimens with denticulate outer lip, presumably mature, 45 × 23 and 46 × 21 mm.

Pale horny or biscuit-coloured, glossy when fresh; some half-grown specimens show 4–5 faint bands of slightly darker spots; interior of aperture faintly pinkish or orange. As preserved, animal dark; in life it might possibly be mauve or purplish (cf. *lutosa*, *infra*).

Radula with 100–105 rows; the oblique hind margins of the lateral teeth are sometimes slightly crenulate.

Off Cape of Good Hope (Adams & Reeve, Watson); 34° 6′ S. 18° 6′ E., 117 fathoms (Studer); 34° 43′ S. 18° 30′ E., 125 fathoms (Sowerby); 33° 41′ S. 18° 0′ E., 178 metres; 35° 16′ S. 22° 26′ E., 155 metres; and 34° 33′ S. 18° 21′ E., 318 metres (von Martens).

30° 2′ S. 15° 2′ E., 199 fathoms (s.s. *Africana*, per U.C.T.).

Numerous stations along the south-western slope of the continental shelf off Cape Point and the west coast of the Cape Peninsula, 85–230 fathoms, live and dead specimens; also dead shells from the Agulhas Bank and its southern margin (*vide infra*) (S. Afr. Mus. P.F. coll.).

Remarks. Plump and slender individuals occur: e.g. 70 × 33 and 68 × 28 mm. The protoconch is almost always more or less corroded.

Typically the axial ribs and spiral lirae are approximately equally strong. But there is a tendency for the spiral lirae to become weaker or even obsolete, thus producing a ribbed instead of a cancellate sculpture. This is well shown in a series of 11 specimens (24–38 mm. long) containing both cancellate and ribbed examples from Brown's Bank, approx. $36\frac{1}{2}$° S. 21° E., 100–200 fathoms. The first row of prickles near the suture, and the 2nd row are distinct (and sometimes the 3rd), but across the middle of the whorl they disappear, leaving the axial ribs smooth; the spiral lirae reappear towards the base (P.F. coll.).

Three ribbed examples, 27–36 mm. long., were also taken off Cape Seal, 80 fathoms, and off Cape St. Blaize, 85–90 fathoms (P.F. coll.).

Two dead examples (one of them given to Tomlin) from 34° 34′ S. 18° 32′ E., 100 fathoms, 60 × 29 mm.: sharp cancellate sculpture but spiral lirae on body whorl tending to greater prominence than the axial ribs: protoconch narrower than in typical examples, diam. 1·5 mm. (slightly corroded); columella pleats 2 with one intermediary and 3 above very feeble; parietal glaze adnate to shell without free edge; outer lip broken away. In some respects approaching *lutosa* (P.F. coll.).

Four living and 2 dead examples, 31 × 16 to 35 × 17 mm. long, from off South Head, Saldanha Bay, 190 fathoms: protoconch diam. 2 mm.; axial ribs predominating, sculpture in the youngest sharp, in the others more or less corroded; columella pleats 2 plus 4 small (in the youngest), 1 plus 6 or 7, the latter decreasing in size posteriorly (2 specimens), 2 plus 1 intermediary and 3 small above (2 specimens); parietal glaze with free edge except in the youngest; outer lip except in the youngest thickened by close aggregation of growth-lines externally, internally feebly denticulate and plicate in one specimen, with obscure traces of denticles in two others. Radula as in *abyssicola* (P.F. coll.).

In having a free edge to the parietal glaze these specimens also approach *lutosa.*

One living and one dead from off Duminy Point, 87 fathoms (slightly farther north than South Head), 45 × 22 (living), 50 × 24 mm. (dead): apex 'acute', protoconch narrow, diam. 1·5 mm.; cancellate sculpture sharp on upper whorls, somewhat corroded on body whorl; columella pleats 3, upper one small, plus 2 obscure (smaller specimen), 2 plus 1 intermediary and 1 above obscure (larger specimen); parietal glaze with free edge; outer lip broken. Radula as in *abyssicola* (P.F. coll.).

These shells appear to be referable to *lutosa.*

var. *lutosa* Koch

1948. Koch. *J. Conch.*, xxiii, p. 5, pl. 2.

Similar to *abyssicola.* Koch said 'apex acute', but the acuteness appears due to corrosion; sculpturing not so sharp, which is also due to corrosion, young specimens being like *abyssicola*; columella pleats 3–5, the upper 2–3 being feeble; in larger examples the parietal glaze thicker, nearly concealing the sculpture on body wall, because the animal deposits the glaze over the layer of clay covering the shell, consequently when the shell is cleaned the edge of the glaze is free not adnate. 80 × 35 mm. (Koch).

Cream (when not corroded), interior of aperture pale orange-brown, animal mauve (Koch).

Off Port Nolloth and Orange River mouth, 40–60 fathoms (Koch).* 32° 9′ S. 18° 6′ E., 59 fathoms (s.s. *Africana*, per U.C.T.). Frequently encased in stiff red-brown or umber-brown clay.

Remarks. The P.F. examples described above as variants of typical *abyssicola* impair the validity of this form as a full species. I regard it, at most, as a variety. The two forms seem to overlap in the vicinity of Saldanha Bay, and the slight differences appear to be due to habitat.

I have seen 15 *Africana* examples (AFR. 718 B.) from 26 to 75 mm. long.

* In the same American dealer's catalogue mentioned in the footnote, p. 23, a 'Paratype' was offered for sale.

Volutocorbis gilchristi (Sow.)

1902. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 99, pl. 2, fig. 5.

Spire high, aperture $1\frac{3}{4}$ times spire. Protoconch diam. 1·5 mm. (broken). Postnatal whorls 4; axial ribs *c.* 22 on 1st whorl, *c.* 24 on body whorl (Sowerby: 16, ? typ. err. for 26); spiral lirae obscure on 1st–3rd whorls, but distinct on body whorl, especially towards base; top of whorl projecting above the sunken suture as a crenulate or denticulate ridge, somewhat corroded and not so noticeable on upper whorls; 2nd spiral lira separated from ridge farther than the following lirae one from another. Columella pleats 6, decreasing in size posteriorly. Outer lip reflexed, thickened, several closely aggregated growth-lines forming a stout varix externally, internally obscurely denticulate. Parietal glaze slight, adnate to shell. 30 × 15 mm. (Sowerby); 28 × 13 mm. (cotype, S. Afr. Mus.).

White with pale cream glassy periostracum.

Off Cape Natal (Durban), 200 fathoms (Sowerby).

Same locality, 185–200 fathoms (S. Afr. Mus. P.F. coll.).

Type ? in coll. Sowerby (? Brit. Mus.); cotype in S. Afr. Mus.

Remarks. Distinguished by the deeply sunken suture. Von Martens when describing (1903) *epigona* from East Africa did not mention *gilchristi*; and Thiele in his Handbuch (1929, p. 345) seems to recognize *abyssicola* and *epigona* as the only two species in the genus.

V. epigona (1903. *D. Tiefsee Exp.*, vii, p. 106, text-fig.) is slightly larger than *gilchristi* (text said 30 mm., but the line alongside the enlarged figure measures 33 mm.). It differs in having 8 columella pleats, the upper ones much more strongly developed than in *gilchristi*; and strong plicae within the outer lip which is not thickened. The suture is not mentioned, but judging by the figure, is not so deeply sunken.

Gen. Fulgoraria Schumacher

Columella with 6–8 pleats.

Saotomea Habe 1943 was described as a section or subgenus with one columella pleat and a lozenge-shaped operculum.

Fulgoraria blaizei n. sp.

Fig. 8(*b*)

Aperture subequal to spire. Protoconch mammiliform, 2 ($2\frac{1}{2}$) whorls, diam. 2·8–3·5 mm., smooth, junction with 1st postnatal whorl indistinct in three specimens but abrupt in the 24 mm. specimen. Postnatal whorls 4, profile evenly curved, without shoulder; slightly arcuate low axial ribs 16–18 on 1st whorl, 18–20 on 2nd, ill-defined and petering out on 3rd whorl; fine spiral lirae traceable only on 1st and 2nd whorls. Growth-lines fine, arcuate.

About 20 spiral lirae on base. Aperture narrow ovate, canal rather short. Columella with one pleat, best seen on the 39 mm. specimen (taken alive), very indistinct on the dead ones. 42 × 15 mm., 39 × 11·5 mm., 24 × 9·5 mm., 18 × 6·5 mm.

Operculum obovate, nucleus apical (but apex broken), 8·5 × 3·5 mm. in 39 mm. shell with aperture 17 mm.

Uniform salmon-buff, protoconch white, operculum pale amber; the two dead specimens pale buff.

Off Cape St. Blaize, 73 miles, 125 fathoms, one 42 mm., one 24 mm., and one 18 mm., dead; same locality, 105 fathoms, one living 39 mm. (S. Afr. Mus. A3433 type (live), A3430 cotypes. P.F. coll.).

Remarks. Provisionally placed in the genus *Fulgoraria.*

There is no record whether these specimens were submitted to Sowerby; probably not. Nor is it known when the animal was removed from the only specimen taken alive.

The spiral lirae are finer and closer together in the 42 mm. and 24 mm. specimens, than in the type and the smallest specimen.

Gen. Fusivoluta von Martens

1902. Von Martens. *SB. Ges. naturf. Fr. Berlin*, p. 237.

Operculum oval, nucleus apical, curved to left. Columella without pleats. Radula with tricuspid central tooth, no lateral.

Fusivoluta pyrrhostoma (Watson)

Figs. 7(*b*), 9(*b*)

1882. Watson. *J. Linn. Soc. Lond.*, xvi, p. 374 (*Fusus* (*Sipho*) *p.*).
1886. id. *Challenger Rep.*, xv, p. 208, pl. 12, fig. 2 (*Fusus* (*Sipho*) *p.*).
? 1889. Studer. *Forschungsreise Gazelle*, iii, pp. 52, 54 (*Fusus mandarinus*, non Duclos).
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 226, pl. 3, fig. 1 (shell, operculum, radula, anatomy).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 32, pl. 3, fig. 15.
? 1903. id. ibid., p. 33 (*Fusus mandarinus*, non Duclos).
1903. Thiele. ibid., p. 171, pl. 9 (4), fig. 67 (radula).

Aperture subequal to spire. Protoconch 2½ whorls, diam. 2·5 mm. Postnatal whorls 5; axial ribs on 1st whorl 13–14, on body whorl 15–20, but gradually becoming obsolete, arcuate, beginning at suture and sometimes forming a very slight shoulder, obsolete on base, sharp (when not worn), narrower than intervals; crossed by *c.* 15–18 or 20 spiral lirae. Columella slightly curved, parietal glaze concealing sculpture, adnate to shell without free edge. 42 × 17 mm. (*Challenger*: 38 mm.).

Operculum 12 × 5 mm. in 42 mm. shell.

Dull white, fresh specimens with very thin pale fawn periostracum, aperture internally pale orange-salmon.

Radula 1·5 mm. long, with *c*. 45 rows. Thiele's specimen was also 1·5 mm. long.

34° 41′ S. 18° 36′ E., 98 fathoms (Watson); 33° 59′ S. 17° 52′ E., 50 fathoms (Studer); 34° 20′ S. 18° 36′ E., 70 metres, and 34° 33′ S. 18° 21′ E., 318 metres (von Martens). Sowerby gave no locality.

Mouth of False Bay and off Cape Point and the west coast of the Cape Peninsula, 45–200 fathoms; Brown's Bank (approx. 36½° S. 21° E.), 80–100 fathoms; Cape St. Blaize, distant 73 miles, 125 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. It is most unlikely that the New Zealand *Fusus mandarinus* occurs off Cape Point. Moreover von Martens's characterization of the two dead *Gazelle* shells might well apply to some of the present examples: superficially ('aüsserlich') similar [to *pyrrhostoma*] with narrower ('feinere') apex unlike that of a *Voluta*, ribs disappearing on 6th [i.e. penultimate or 4th postnatal whorl] and relatively greater length of the visible portion of the whorls; 31 mm. long. Except for the last, rather vague, character there are similar *worn* shells in the P.F. series with narrow pointed protoconch.*

The columella is usually more curved than in Watson's figure.

forma *major* n.

Figs. 7(*c*), 9(*c*)

Two specimens considered by E. A. Smith and L. J. Shackleford to be extra large specimens of *pyrrhostoma*.

Off South Head (Saldanha Bay), 190 fathoms. 60 × 24 mm., smaller specimen 55 × 22 mm. with protoconch and operculum, taken alive but animal not preserved (A3429).

Both specimens much corroded, even the live one. Traces of axial ribs remain on the 3rd and 4th whorls, but apparently they were not developed on the body whorl, thus resembling the typical form (S. Afr. Mus. P.F. coll.).

A live specimen, 74 × 25 mm., was taken by the s.s. *Africana* (AFR. 738 D., submitted per U.C.T.) at 30° 21′ S. 16° 50′ E., 185 metres. Protoconch and upper whorls corroded. Postnatal whorls 6; axial ribs well marked but feeble and irregular on back of last whorl and outer lip; spiral lirae obsolete. Radula 5 mm. long, with 58 teeth.

Fusivoluta capensis (Thiele)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 179, pl. 31 (19), fig. 27 (*Glypeuthria ? c.*).
1931. Tomlin. *Ann. S. Afr. Mus.*, xxx, p. 165, fig. 6 (*Glypeuthria capensis*, non Thiele).
1945. id. *J. Conch.*, xxii, p. 135 (*Glypeuthria sculpturata* nom. nov. for *capensis* Tomlin preocc.).
1957. Barnard. ibid., xxiv, p. 210 (radula, generic position).

* Krauss (1848, p. 110) mentions the similarity of his *Fasciolaria badia* (= *lugubris* Rve.) to *Fusus mandarinus*; the *Gazelle* shells may be this species, but I think they are far more likely to be *pyrrhostoma*.

Aperture slightly shorter than spire (by about the length of the protoconch). Protoconch 2 whorls, diam. 2 mm. (but corroded). Postnatal whorls 6. Axial ribs 12–14 on 1st whorl (but this whorl usually corroded), 18 on body whorl, slightly arcuate, beginning at suture, extending across base; crossed by 18–20 strong spiral lirae which are finer in the upper part of the whorl near suture. Columella curved, canal short; parietal glaze concealing sculpture, adnate, without (sometimes very slight) free edge. 38 × 15 mm.

Operculum oval, nucleus apical (but usually broken), curved to left, 7 × 4 mm. in 29 mm. shell.

Greyish white, operculum amber coloured.

Radula 2·75 mm. long, with 45–50 teeth, indistinguishable from that of *pyrrhostoma*.

35° 9′ S. 18° 33′ E., 564 metres (Thiele); off Cape Point, 318–400 fathoms (Tomlin).

In addition to those sent to Tomlin, there are specimens from between 250 and 560 fathoms off Cape Point (S. Afr. Mus. P.F. coll.).

Remarks. Comparison of the smallest P.F. specimen, although twice as large as Thiele's *Valdivia* specimen, with his figure leaves no doubt as to the identity. Tomlin did not see this specimen. Nor was any animal sent to Tomlin.

This species appears to live in deeper water than *pyrrhostoma*.

Though the two species have a slightly different appearance—*capensis* is less fusiform and more distinctly spirally lirate—the descriptions read very much alike as regards details. Possibly intergrading forms will be found.

Fusivoluta decussata n. sp.

Fig. 8(*c*)

Aperture (as preserved) subequal to spire without protoconch. Protoconch mammiliform, 2 (2½) whorls, diam. 3·5 mm., smooth but with a few axial pliculae towards the junction with 1st postnatal whorl where the spiral lirae start. Postnatal whorls (as preserved) 4, profile evenly convex; with slightly arcuate axial ribs and spiral lirae producing a cancellate sculpture, the ribs a little more prominent than the lirae, intersections slightly nodulose; *c.* 30 ribs on 1st whorl, *c.* 45 on 2nd, 55 on last whorl (but some feebler and closer together than others making an exact count difficult); 7 lirae on 1st whorl, 8 on 2nd, 9 on 3rd, and 10 on last whorl, about 6 additional on base. Columella slightly curved, without pleat. Aperture oval, canal narrow (but lip broken). 35 × 12 mm.

Buffalo River (East London), 15 miles, 310 fathoms, one dead specimen and one fragment of a juv. (S. Afr. Mus. A3432. P.F. coll.).

Remarks. This distinctive shell is placed provisionally in *Fusivoluta*, although the animal is unknown. The protoconch is larger than in *pyrrhostoma*, and relatively larger than in *anomala* von Martens.

Fusivoluta elegans n. sp.

Fig 8(*a*)

Aperture a little longer than spire (11 : 8 mm.). Protoconch $1\frac{1}{2}$–2 whorls, alt. 1 mm., diam. 1·2 mm., smooth, with a few axial pliculae towards junction with 1st postnatal whorl. Postnatal whorls $4\frac{1}{2}$–5, profile convex, on the lower whorls the upper part flat but without definite shoulder. Axial ribs 13 or 14 on 1st whorl, 15 on 2nd, 16 on 3rd, 17 on 4th, and 19 on last whorl; on penultimate and last whorl the growth-lines become prominent and form intermediary riblets, usually 2 (3) between each pair of main ribs; ribs obsolete on base; crossed by spiral lirae 5 on 1st whorl, 7 on 2nd, 9 on 3rd, 12 on 4th and 13–14 on last whorl; on 3rd–5th whorls lirae slightly stronger on the lower convex part than on the upper flat part of whorl, intersections with main ribs slightly nodulose, those with the intermediaries a little more conspicuous, *c.* 20 additional lirae on base. Columella almost straight, without any indication of a pleat. Canal rather long. 19 × 6·5 mm.

Off East London, 400 fathoms, one dead (S. Afr. Mus. A8803. P.F. coll.).

Remarks. Placed in *Fusivoluta* because the sculpturing is essentially similar to that of *pyrrhostoma*, *anomala* and *capensis*. The size of the protoconch (unworn), however, indicates a smaller species.

Somewhat resembling in shape *hilgendorfi* von Martens (1897) placed in the genus *Benthovoluta* Kuroda & Habe (1950. *Illustr. Cat. Jap. Sh.*, no. 5).

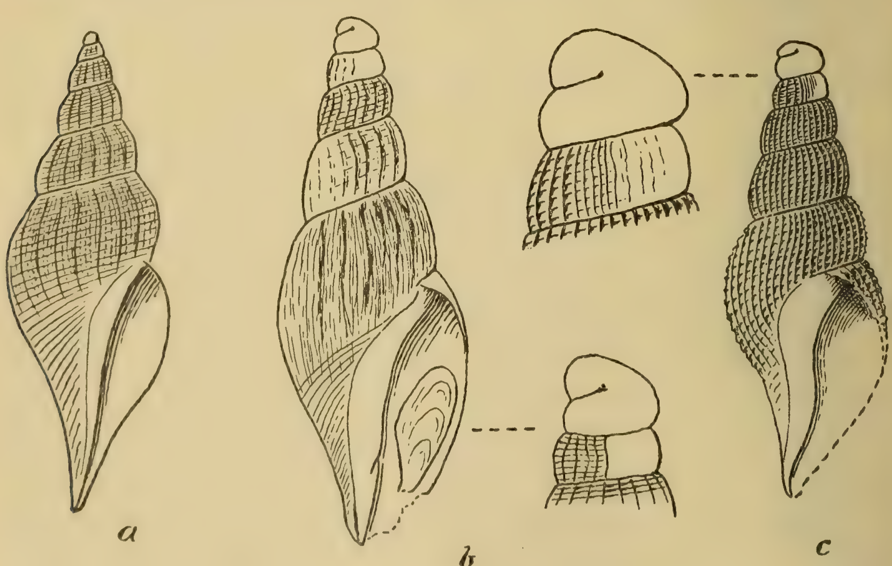


Fig. 8.

(*a*) *Fusivoluta elegans* n. sp. (*b*) *Fulgoraria blaizei* n. sp., with protoconch further enlarged. (*c*) *Fusivoluta decussata* n. sp., with protoconch further enlarged.

Gen. NEPTUNEOPSIS Sow.

1898. Sowerby. *Mar. Invest. S. Afr.*, i, p. 5 (exact date ? printer's order number on cover of reprints gives . . . 3, 1898, which presumably means March).
1900. Woodward. *Proc. Mal. Soc.*, iv, p. 120 (anatomy).
1902. Pace. ibid., v, p. 25 (anatomy).

Columella without pleats. Operculum ovoid, nucleus apical. Radula with tricuspid central tooth and degenerate lateral.

The genus is monotypic.

Neptuneopsis gilchristi Sow.

Fig. 9(*d*)

1898. Sowerby. loc. cit., p. 6, pl. 1 (shell, operculum, radula).
1900. Woodward. loc. cit., p. 120, pl. 10, figs. 2, 3, 11, 13, 14.
1902. Pace. loc. cit., p. 25, pl. 2, figs. 5–8.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 33.
1903. Thiele. ibid., p. 171, pl. 9 (4), fig. 68 (radula).

Protoconch conical, apex pointed, usually slightly lop-sided, size variable: 9 × 6, 9 × 7, 10 × 6·5, 11 × 7, 11 × 8·5 mm. Postnatal whorls 6; finely striated axially and spirally, growth-lines coarser, surface dull. Aperture subequal to spire. Outer lip slightly reflexed. Up to 198 × 70 mm.

Shell pinky-white, periostracum amber-brown or greyish-brown, or slightly olivaceous, operculum chestnut-brown.

Radula: see p. 35.

Off 'Cape of Good Hope', 33 fathoms [34° 17′ S. 18° 35′ E., False Bay] living (Sowerby); 35° 10′ S. 23° 2′ E., 500 metres, living (von Martens).

Off west coast of Cape Peninsula, 160 fathoms, living (U.C.T. ex trawler).

Off west coast of Cape Peninsula, 60–91 fathoms, living (S. Afr. Mus. P.F. coll.).

Agulhas Bank: off Cape St. Blaize and Flesh Point, 33–105 fathoms, dead; off Nanquas Peak (eastern part of Algoa Bay), 49–59 fathoms, dead (S. Afr. Mus. P.F. coll.).

S. Afr. Mus. also has two specimens with opercula from the Ross-Frames collection, without record of how or where obtained, but probably purchased from trawlers.

Remarks. The most notable of the many novelties obtained by the *Pieter Faure*.

In the Report of the Government Biologist for 1897, p. 10, there is no mention of the capture of this large mollusc, nor in fact of any of the captures except fishes.

There was formerly (about 1917) in the Museum of the Zoology Department of the South African College (where Dr. Gilchrist was Professor of Zoology) a dry shell labelled 'Type'. This may possibly have been the Type,

but it appears to have been lost when the Zoology Department moved out to the new University buildings in the suburbs.

A specimen, shell and animal in alcohol in S. Afr. Mus., was taken on 8 September 1897 at Station IX in False Bay (34° 17′ S. 18° 35′ E.) in 33–40 fathoms, bottom fine white sand. The shell is 170 mm. in length; the operculum has not been removed from the animal, which has not been dissected. This specimen therefore cannot be the Type.

Only two other living specimens were taken, both off the west coast of the Cape Peninsula, one in March 1900, the other in August 1903 (both in S. Afr. Mus., from one of which I have removed the radula).*

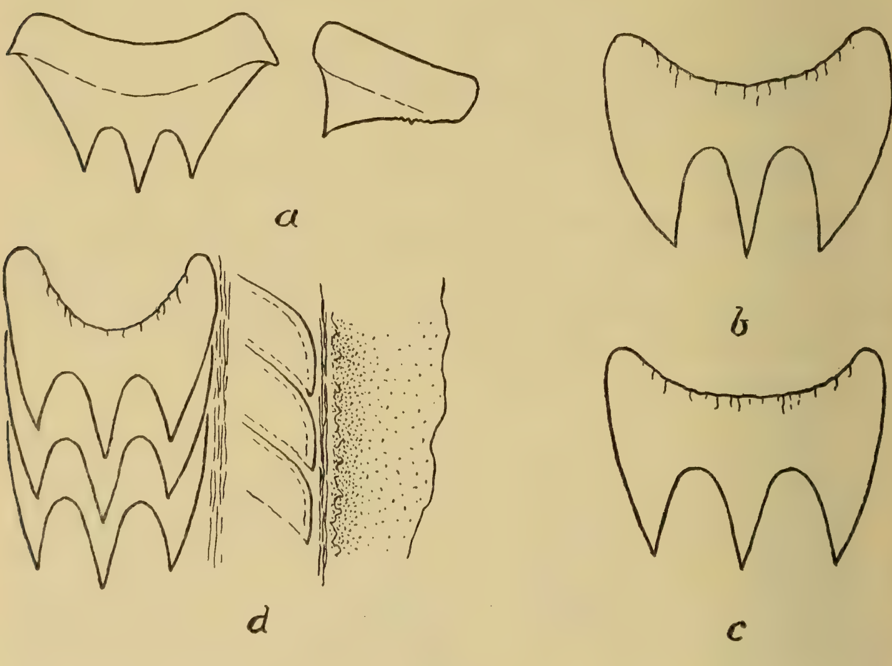


Fig. 9.

(*a*) *Volutocorbis abyssicola* (Ad. & Rve.), central and lateral plates of radula. (*b*) *Fusivoluta pyrrhostoma* (Watson), central plate of radula. (*c*) *F. pyrrhostoma* forma *major*, central plate of radula. (*d*) *Neptuneopsis gilchristi* Sow., three central plates with degenerate lateral plates from near front end of radula; the expansion of the basal membrane thins out laterally as indicated by the spacing of the dots.

It seems therefore that *two* living specimens were taken at Station IX in False Bay. One sent to Sowerby and described by him in 1898; he himself seems to have extracted the radula and passed the animal (thus mutilated) on

* Pace (loc. cit., p. 21 and p. 25 footnote 2) records that the British Museum secured a spirit specimen (reg. no. 1901: 10.29.10) in 1901, which he dissected. There seems to be no record in the *Pieter Faure* log-book of the capture of this specimen.

to Woodward for dissection (see Woodward 1900, and Pace 1902). The second specimen is that now in S. Afr. Mus.; it can be regarded as no more than a topotype.

The *Valdivia* obtained a living example at 500 metres on the southern slope of the Agulhas Bank, indicating that the habitat probably extends westwards along the slope of the continental shelf to Cape Point and along the western coast of the Cape Peninsula. The locality at the mouth of False Bay may be regarded as an outlier, or possibly an exceptional occurrence.

The *Pieter Faure*, whose primary object was the discovery of inshore commercial fishing grounds, scarcely touched the southern fringe of the Agulhas Bank; which probably explains why only dead shells were obtained, except on the three occasions mentioned.

These dead shells came from two areas: one south of Flesh Point and Cape St. Blaize, the other at the eastern end of Algoa Bay. These two 'pockets' seem to indicate bottom currents flowing inshore, either westwards or possibly as reverse compensatory currents eastwards. As yet it is impossible to say whether the shells from the Algoa Bay pocket indicate a habitat of the living mollusc farther east on the continental shelf towards East London.

Radula (fig. 9*d*). Pace (loc. cit., p. 27 footnote 1) said, 'Sowerby's figure shows such discrepancies from my preparation that I venture to question whether the radula of . . . e.g. *Cymbiola ancilla*, may not have been accidentally substituted . . .'. This statement is quite unjustified. Pace's own figure (pl. 2, fig. 8) is quite comparable with those of Sowerby and Thiele (except for the inclusion of the lateral teeth), but none of these three figures is comparable with Pace's figure of *C. ancilla* (pl. 2, fig. 9); in the former the notches between the cusps are U-shaped, in the latter V-shaped.

In the specimen examined by me the teeth are closer together than in Sowerby's and Thiele's figures, more as drawn by Pace.

Pace (p. 28) said the lateral teeth disintegrated so rapidly in KOH that he had no time to make a drawing. He is perfectly correct in recording their presence. They can, however, scarcely be called teeth as they have no free margins; they are in fact indicated only by oblique thickenings in the basal membrane. They correspond in number with the central teeth, and are undoubtedly degenerate lateral teeth. There are 70–75 rows.

Fam. *HARPIDAE*

1916. Melvill. *J. Conch.*, xv, pp. 25–40.
1939. Peile. *Proc. Mal. Soc.*, xxiii, p. 271, fig. (radula).

The only specimen of this family obtained by the P.F. was a 45 mm. *H. conoidalis* Lam. (identified by Sowerby), from off Umvoti River (Natal), 27 fathoms.

Also obtained at Delagoa Bay (U.W.).

Fam. *VASIDAE*

Bartsch (1915, p. 42) records *Xancus globulus* Chemn. from 'Cape of Good Hope'. This is certainly not an indigenous South African species.

Vasum turbinellum (Linn.) is also doubtfully indigenous, though it occurs at Mozambique Island (U.W.).

Turton's 'Xancus sp.' (1932. p. 45, pl. 10, no. 333), 3·5 × 2 mm., appears to be a juvenile *Mitra*.

Vasum truncatum Sow.

Fig. 10

1892. Sowerby. *Mar. Sh. S. Afr.*, p. 17, pl. 4, fig. 85 (adult, worn).
1902. Smith. *J. Conch.*, x, p. 249, pl. 4, fig. 6 (*triangularis*, juv.).
1903. id. *Proc. Mal. Soc.*, v, p. 370, pl. 15, fig. 3 (adult).

Shell thick in adult, conical, spire very low but in juvenile protoconch and first whorl (or first two whorls) forming a projecting papilla. Protoconch: *v. infra*. Postnatal whorls 6. Shoulder with *c.* 11 blunt knobs, whose inclusion in succeeding whorls produces an undulate suture. Base with 4 or 5 blunt spiral ridges, more or less interrupted and nodose. Columella with 4 pleats, more or less equally strong; rimate anteriorly at snout but umbilicus open. Periostracum thick, scabrous with close-set growth-lines.

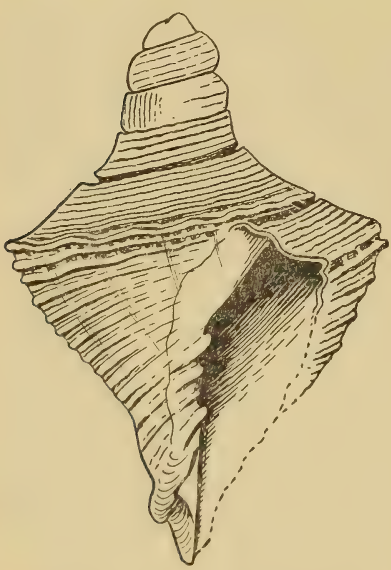


Fig. 10.
Vasum truncatum Sow., protoconch and first two postnatal whorls of juvenile 15 × 10 mm.

65 × 50 mm. (Sowerby); 48 × 35 mm. (Smith); 66 × 55 mm. (S. Afr. Mus. beach-worn, protoconch and first 3 or 4 whorls missing and end of canal worn); 41 (protoconch missing) × 32 mm., and 55 × 43 mm. (width across shoulder knobs) (S. Afr. Mus., the latter specimen retains most of the periostracum).

Port Elizabeth, Port Alfred (Sowerby, Bartsch, Turton); Port St. Johns (S. Afr. Mus.). In deep water off Durban and Port Shepstone (Smith); off Durban (S. Afr. Mus.).

A juvenile obtained by the P.F. off Umkomaas River (Natal), 40 fathoms, is worth a separate description and figure. 15 × 10 mm. Protoconch $2\frac{1}{2}$–3 whorls, papilliform, gradually passing into first postnatal whorl without distinct junction; 1st whorl somewhat worn, 2nd with 5 or 6 very faint spiral carinulae, superseded at $2\frac{1}{2}$ whorl by faint and

irregularly spaced axial pliculae, *c.* 16 in three-quarters of a whorl (may be either protoconch or 1st postnatal whorl). Postnatal whorls 2, the axial pliculae superseded by 6 spiral lirae, the lower 2 more prominent and forming a double peripheral keel. On 2nd whorl *c.* 8 lirae above the keel, below the keel *c.* 12 additional lirae with a weaker intermediary between each pair. Faint spaced growth-lines are traceable, but no axial ribs; the circumference, however, when seen from the apex is gently undulate, *c.* 11–12 lobes on 1st and 2nd whorls; these undulations are not prominent enough to cause nodulose projections on the base as they do in larger examples. Columella pleats 4, the 3rd thinner than the others (as is the case in two larger specimens 41 and 55 mm. in length). Snout slightly rimate.

Remarks. Type of *truncatum* in Bairstow collection (Oxford Mus.); of *triangularis* in British Museum.

Smith (1903) gave an emended description and recognized his *triangularis* as the not fully adult of *truncatum*; but he did not give the size of his Port Shepstone adult.

Fam. *MITRIDAE*

1919. Cooke. *Proc. Zool. Soc. Lond.*, p. 405 (classification according to radulae).
1922. Peile. *Proc. Malac. Soc.*, xv, p. 93 (radulae).
1936. id. ibid., xxii, p. 141 (radulae).
1937. id. ibid., xxii, p. 181 (radulae).

Cooke's paper on the radulae was based on the Gwatkin collection in the British Museum. Unfortunately, it seems that reliance cannot always be placed on the correct naming of the slides. Some errors have been detected (e.g. *Euthria queketti*). Suspicion also arises in one case in this family, namely '*circula* var.', under which Cooke (p. 415) said: 'There is evidently some confusion in the specimens forwarded [to Gwatkin] by Mr. Burnup. . . .' But this did not prevent the description of a new species *burnupiana*! (see pp. 48-49).

The results contained in Peile's papers, which were based on radulae extracted by himself from the respective shells, are far more acceptable.

Gen. Mitra Lam.

More or less fusiform. Central plate of radula more or less quadrate, with comparatively few (4–8) cusps, lateral plate broader, usually considerably broader than central, usually with numerous cusps, of which one or two may be enlarged. Ocasionally both central and lateral plates are unicuspid. The group containing *circula* has an arcuate central plate with numerous small cusps, the lateral also with numerous small cusps.

Mitra caffra (Linn.)

1758. Linne. *Syst. Nat.*, ed. 10, p. 732 (*Voluta c.*).
1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 208.
1935. Dautzenberg. *Mem. Mus. R. Hist. Nat. Belg.*, H.S. II, 17, p. 120 (*Turricula c.*) (references).

Aperture $1\frac{1}{4}$–$1\frac{1}{3}$ times the spire. Postnatal whorls 8 (S. Afr. Mus. specimen). Axial ribs 16–18 on early whorls, decreasing to 14–16, and becoming obsolete on 7th whorl; crossed by 3–4 spiral striae, 5 on body whorl, about 15 additional striae on base becoming stronger anteriorly. Columella pleats 4; outer lip plicate within. 40 × 15 mm. (S. Afr. Mus. specimen).

Chestnut-brown, with pale yellow or white peripheral band, and a second band in middle of base and outer lip, base below this band somewhat yellowish. Delagoa Bay (U.W.); Inhambane (U.C.T.); Mozambique (S. Afr. Mus.).

Distribution. Dar-es-Salaam (S. Afr. Mus.), East Indies, Philippine Islands, China.

Remarks. Two very worn specimens in the Ross-Frames collection labelled as from Mozambique.

As '*Mitra* sp.' Turton (1932. *Mar. Sh. Port. Alfred*, p. 46, pl. 10, no. 343) mentions 3 specimens, 26 mm. long, light brown with a darker band at the sutures. The photograph shows a dark shell with a light band above the suture and apparently on the upper part of the outer lip. The summit is very rounded, and the shell is obviously in an advanced stage of 'beach-wear'.

The resemblance of the photo to *caffra* is noticeable, and by grinding down one of the above-mentioned Mozambique specimens a very fair imitation of Turton's shell was obtained. There is, however, one difficulty in the way of this explanation: presumably the summit of Turton's specimen is solid shell (the photo is not at all clear), whereas in the artificially produced imitation the hollow interior of the whorl is exposed.

Turton's specimens (in spite of their condition!) should be re-examined.

Mitra euzonata Sow.

1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 4, pl. 1, fig. 11.

Axial ribs 11 on 1st whorl, 15–16 on last whorl; spirally punctate-striate (Sowerby). 10 × 4·5 mm.

White with an orange-brown peripheral band.

Remarks. Very likely merely a colour variety of *Vexillum capense.* The suture is no deeper than in the latter.

Mitra kowieensis Sow.

1901. Sowerby. *Proc. Mal. Soc.*, iv, p. 213, pl. 22, fig. 17.
1932. Turton. *Mar. Sh. Port Alfred*, p. 47, pl. 10, no. 352 (*helena*, non Bartsch.).
1932. id. ibid., p. 47, pl. 10, no. 353 (*eucosmia*).
1933. id. *J. Conch.*, xix, p. 370 (*becki* nom. nov. pro *helena* preocc.).

Aperture subequal to spire. Protoconch $1\frac{1}{2}$ whorls. Postnatal whorls 4 (Sowerby: 6, i.e. incl. protoconch), profile slightly shouldered. Axial ribs 11 on 1st whorl, 13–14 on last whorl, slightly narrower than intervals, extending across base; spiral striae 4 on 1st and 2nd whorls, 5–6 on later whorls, crossing

the ribs, on base 4 additional striae (i.e. 5 lirae) followed by 4–5 stronger lirae, intersections with ribs nodulose. Columella pleats 4. 6 × 2·5 mm.

White; Turton says fresh specimens are slightly pink.

Kowie (Port Alfred).

Remarks. Turton said there were broad and narrow individuals, but in spite of this he created a n. sp. (*helena*, renamed *becki*); *eucosmia* is obviously also a synonym, although it has fewer spiral striae (cf. *capense*). Probably synonymous with *V. capense*.

Two dead P.F. specimens appear to correspond with the narrow form (*becki*) of *kowieensis*: off Tugela River (Natal), 65–80 fathoms and off Umkomaas (Natal), 40 fathoms (the latter specimen 7·3 × 3 mm.) (S. Afr. Mus. P.F. coll.).

A single specimen from 30° 47′ S. 30° 29′ E., 24 fathoms (U.C.T.), 6 × 2·5 mm., has the protoconch and first two whorls coral pink, the last two maroon with a single narrow white band (actually a series of spots, one on each rib) a little below the periphery.

Mitra distincta (Thiele)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 186, pl. 32 (20), fig. 25.

Scarcely distinct from *kowieensis*. Protoconch 1½ whorls, alt. and diam. 0·75 mm. Postnatal whorls 4, profile shouldered. Axial ribs 11 on 1st whorl, 16 on last whorl; spiral striae 4 on 3rd, 6–7 on last whorl (incl. 1 or 2 obscure on shoulder), crossing ribs, 10–11 additional striae on base. 7 × 3 mm.

35° 16′ S. 22° 26′ E., 155 metres (Thiele); off Cape St. Blaize, 125 fathoms, 2 dead (S. Afr. Mus. P.F. coll.).

Remarks. The ribs become obsolete on the base, not nodulose as in *kowieensis*. Judging by Thiele's figure the present specimens have more ribs than the *Valdivia* specimens; the latter might be re-examined.

Thiele placed his species in *Turricula* (now *Vexillum*) without, however, having a radula for confirmation.

Mitra bathyraphe Sow.

1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 4, pl. 1, fig. 9.
1932. Turton. *Mar. Sh. Port Alfred*, p. 46, pl. 10, no. 348 (*didyma*).

Aperture equal to spire. Protoconch 1½ whorls, alt. and diam. 0·5–0·6 mm. Postnatal whorls 4, profile not shouldered, suture canaliculate, upper edge of whorls slightly undulate or crenulate. Axial ribs 14 on 1st whorl, 16–18 on last whorl, tending to become obsolete on outer lip, subequal to intervals, extending across base; spiral striae 6 on 1st whorl, 9–11 on last whorl, about 12 additional striae on base, becoming stronger anteriorly, intersections with ribs slightly nodulose. Columella pleats 4. 8 × 3·25 mm. Pink.

Kowie (Port Alfred). Off Cove Rock (East London area), 27 fathoms, 3 dead but fresh (S. Afr. Mus. P.F. coll.).

Remarks. The P.F. specimens retain the protoconch, and show the spiral striae crossing the ribs, though they are only feebly impressed on the crest of the ribs. Like beach examples they are pink in colour.

M. didyma is obviously a very worn example of *bathyraphe*.

Mitra canaliculata Sow.

1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 4, pl. 1, fig. 10.

Only beach-worn specimens available in S. Afr. Museum, but they seem to confirm the absence of spiral striae, which is a distinguishing feature.

Mitra latruncularia Rve.

1844. Reeve. *Proc. Zool. Soc. Lond.*, p. 181; and *Conch. Icon.*, pl. 21, fig. 166.
1932. Turton. *Mar. Sh. Port Alfred*, p. 45.

Aperture a little shorter than spire (by about length of protoconch and one whorl). Postnatal whorls 5 (perhaps 6). Spiral grooves crossed by axial growth-lines which cause the former to appear punctate (especially in worn specimens), 5 on uppermost whorl, increasing to 7 on body whorl, 13–14 additional grooves on base, becoming deeper anteriorly. Columella pleats 4. 30 × 10 mm.

Purplish- or greyish-brown, with a broad white band at top of whorl and another from top of aperture around middle of last whorl; the whole with irregularly scattered orange-brown spots, which may here and there unite into short axial flames.

Port Elizabeth (Sowerby), Port Alfred (Bartsch, Turton). Jeffreys Bay and Still Bay (S. Afr. Mus.).*

Remarks. One 30 mm. specimen from Jeffreys Bay has only 10 additional spiral grooves on the base (i.e. 17 grooves on the outer lip instead of 20–21). Although only one out of 10 specimens, this shows that variation in the number of grooves occurs, and form a transition to:

var. *albozonata* Turton (1932. loc. cit., p. 45, pl. 10, no. 335), which has 3 spiral grooves on the uppermost whorl, increasing to 5 on body whorl, and 7–8 additional grooves on base (i.e. 12–13 on outer lip). Up to 26 mm. long (apex worn).

Colour as above, but upper white band usually clearer with fewer spots except actually at the suture, second band not so obvious, sometimes whole shell brown with a few white spots along the suture.

Port Alfred (Turton); Jeffreys Bay (S. Afr. Mus.).

M. latruncularia and *albozonata* cannot be separated at a glance by the coloration, but are easily separated by the number of grooves. *M. albozonata*

* A set of beach-worn specimens in S. Afr. Mus. is registered as obtained by E. L. Layard (Curator 1855–72) in 'Table Bay'; but this locality record is unacceptable.

can be regarded at most as only a variety. The original description does not state the number of spiral grooves, and reference to the type is necessary to show which is f. typica and which the variety.

Mitra picta Rve.

1844. Reeve. *Conch. Icon.*, Mitra, pl. 16, fig. 123.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 53.
1932. Turton. *Mar. Sh. Port Alfred*, p. 46, pl. 10, no. 344 (juv.).

Spire less than aperture (juv. to *c.* 15 mm.), equal to (*c.* 20–25 mm.), then $1\frac{1}{4}$ (half-grown) to $1\frac{1}{3}$ (adult) times the aperture. Protoconch 2 whorls, 2 whorls as hatched alt. 1·75 mm., on later juveniles visible portion alt. and diam. 0·75 mm., smooth. Postnatal whorls 6 or 7 (all adults worn). Spiral punctate striae 6 on 1st whorl, increasing to 12 on body whorl, 12–13 additional striae on base (in adult) becoming stronger anteriorly (24–25 on outer lip); fine close-set growth-lines. Columella pleats 4. 40 × 12 mm.

Castaneous with irregular white marks and flames, sometimes a more or less compact white band in middle of body whorl, the upper part of which appears above the suture in preceding whorls. Worn specimens with the latter pattern may appear at first glance like *latruncularia*, but the larger number of spiral striae easily distinguishes them. Protoconch white, brown patches begin to appear on 2nd whorl (*c.* 4 mm. long.).

False Bay to East London.

Remarks. Protoconchs and juveniles from Still Bay in the Muir collection (S. Afr. Mus.). Not taken by the *Pieter Faure*.

Mitra aerumnosa Melv.

Fig. 11(*a*)

1888. Melvill. *J. Conch.*, v, p. 282, pl. 2, fig. 12.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 31 (*simplex*, non Dnkr.).
1919. Cooke. loc. cit., p. 416 (radula).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 185, pl. 32 (20), fig. 22 (*simplex*, non Dnkr.).
1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 49.

Aperture subequal to spire. Protoconch 2 whorls, alt. 1 mm., diam. 0·75 mm., smooth. Postnatal whorls 6; spiral series of punctae 8–9 on 2nd whorl, 14–15 on body whorl, 16–18 additional series on base, becoming punctate striae anteriorly; growth-lines feeble, but sometimes strong enough to give a semicancellate appearance on the upper whorls. Columella pleats 4, the lowermost one weak. Periostracum thin. 33 × 11 mm.

Buff with a paler median band on body whorl, sometimes only a series of pale spots, sometimes also a series of pale dashes from the suture downwards, periostracum yellowish, olivaceous, or castaneous.

Radula with *c.* 50 rows, central plate 4 times as wide as long, 8-cuspid, lateral about 6 times as wide as long, 14-cuspid.

Fossil, late Tertiary; Saldanha Bay (Haughton).

Algoa Bay (Sowerby); Table Bay and Dassen Island (S. Afr. Mus.); Natal (S. Afr. Mus.). Living: Oudekraal (west coast of Cape Peninsula) and Langebaan (Saldanha Bay) (U.C.T.).

Remarks. The Natal specimen was received from Col. Bowker, but probably not collected in Natal; Turton did not obtain it at Port Alfred; and even the Algoa Bay record is open to doubt.

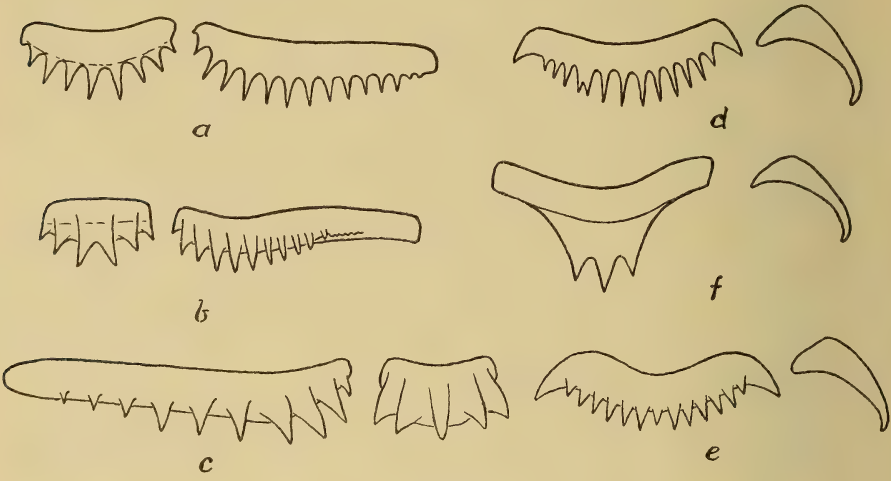


FIG. 11.

Central and lateral radula plates of (*a*) *Mitra aerumnosa* Melv.; (*b*) *M. litterata* Lam.; (*c*) *M.* (*Dibaphus*) *bathybius* n. sp.; (*d*) *Vexillum sculptile* (Rve.); (*e*) *V. capense* (Rve.); (*f*) *Pusia patula* (Rve.).

Thiele disagreed with von Martens's identification of specimens from 34° 51′ S. 19° 37′ E., 80 metres as *simplex* Dnkr.; he figured one but without deciding its specific identity. The figure looks very like an *aerumnosa.*

A series in the Juritz collection (S. Afr. Mus.), probably from the west coast of the Cape Peninsula, contains specimens from 5 mm. long upwards. These show that the lowermost columella pleat does not develop until the shell is 14–16 mm. in length (4 postnatal whorls), and even in adults always remains feeble.

Mitra teretiuscula Thiele

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 185, pl. 32 (20), fig. 23.

Spire subequal to aperture. Protoconch 1½ whorls, alt. and diam. 0·75 mm., smooth. Postnatal whorls 5, profile convex, suture deep but not canaliculate; 4–5 (Thiele said a variable number) fine spiral striae, the one

below the suture usually a little more conspicuous than the others, none on base below periphery; growth-lines arcuate. Columella pleats 4. $9 \cdot 5 \times 3 \cdot 5$ mm.

Yellowish with brown markings: an infrasutural and a median band, with zigzag axial flames (Thiele); the present specimens show only the axial flames.

35° 16′ S. 22° 26′ E., 155 metres (Thiele); off Cape St. Blaize, 125 fathoms, 3 dead; off Cape Morgan, 45 fathoms, 2 dead (S. Afr. Mus. P.F. coll.).

Remarks. The rounded profile of the whorls, and the fewer spiral striae distinguish this species from *aerumnosa.* Moreover the latter is a larger species with only 3 whorls at 9 mm. length. Thiele's figure shows the columella pleats more oblique than in the present specimens.

In slightly worn specimens the uppermost stria (below the suture) persists when the others have become untraceable.

Mitra (*Papalaria*) *episcopalis* Linn.

1833. Quoy & Gaimard. *Voy. Astrolabe. Moll.*, pl. 45, figs. 1–7 (living animal).
1859. Chenu. *Man. Conchyl.*, i, fig. 996.
1880. Von Martens. *Mauritius & Seychellen*, p. 249.
1919. Cooke. loc. cit., pp. 406, 408 (radula).
1935. Dautzenberg. *Mem. Mus. R. Hist. Nat. Belg.*, H.S. II, 17, p. 44 (references).

Radula with 71 rows, central plate 8–9-cuspid, lateral 20–22 cuspid, the cusps diminishing to mere serrations at outer end (Cooke).

Distribution. Mozambique (Smith), Zanzibar, Mauritius, Madagascar, Indo-Pacific.

S. Afr. Mus. has this well-known species from Mozambique.

Von Martens records that the living animal exudes a purple-brown fluid which stains the hands reddish-brown, and smells like green walnuts.

Mitra (*Papalaria*) *pontificalis* Lam.

1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 198.
1859. Chenu. *Man. Conchyl.*, i, fig. 1030.
1880. Von Martens. *Mauritius & Seychellen*, p. 250.
1935. Dautzenberg. loc. cit., p. 53, pl. 2, figs. 8, 9 coloured (and var. *confluens*) (references).

Three specimens in the Ross-Frames collection (S. Afr. Mus.) labelled as from Mozambique.

Distribution. Zanzibar, Mauritius, Madagascar, Indo-Pacific.

Mitra (*Strigatella*) *limbifera* Lam.

1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 214.
1859. Chenu. *Man. Conchyl.*, i, fig. 1003.
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 44 (*carifa*).
1919. Cooke. loc. cit., pp. 410, 411 (radula).
1935. Dautzenberg. loc. cit., p. 88 (*aurantia* var. *l.*) (references).
1936. Peile. loc. cit., p. 142 (radula).

Aperture a little longer than spire. Postnatal whorls 8. Body whorl with 8 spiral grooves, varying in strength, often with fine spiral striae on the flat

ridges, 15–18 additional grooves on base, becoming stronger anteriorly; crossed by close-set slightly retractive growth-lines. Columella pleats 5, the lowermost one usually feeble, sometimes with weak intermediary pleatlets. Periostracum thin. 38 × 16 mm. (S. Afr. Mus.).

Upper whorls and upper half of body whorl yellowish-brown, base darker chestnut brown, periostracum yellowish.

Radula with 86 rows, central plate 7-cuspid, lateral plate with 9–10 short thick cusps, margin external to them bare (Cooke).

Natal (Krauss, Sowerby, S. Afr. Mus.); Durban (Sowerby, Smith, Cooke).

Distribution. Mauritius, Indo-Pacific (*aurantia*), Philippines (*limbifera*).

Remarks. The spiral sculpture varies in strength, and one can speak of 8 spiral grooves or of 4 spiral flat 'cords' with lirae (*carifa*); the spiral grooves are constant on the early whorls, variation occurring on the body whorl; in one specimen the spiral sculpture on the body whorl shows only very faint lirae.

Mitra (Strigatella) litterata Lam.

Fig. 11(*b*)

1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 220.
1859. Chenu. *Man. Conchyl.*, i, fig. 1000.
1919. Cooke. loc. cit., pp. 410, 411, fig. 6 (radula).
1935. Dautzenberg. loc. cit., p. 103 (references).
1936. Peile. loc. cit., p. 142 (radula).

Aperture twice as long as spire. Postnatal whorls 6. Last whorl with 7 spiral rows of punctae (fewer on early whorls), 15–18 additional rows on base, becoming grooves anteriorly. Columella pleats 4. Outer lip with rounded boss in middle internally. Periostracum thin. 30 × 16 mm. (S. Afr. Mus.).

White with brown axial irregular zigzag or undulate markings, periostracum yellowish.

Radula with *c.* 85 rows, central plate with 6 cusps, outermost cusp on either side small, lateral plate wide with 8–10 cusps, outer third of margin smooth. Anterior quarter of radula yellowish-brown, especially dark in front, hinder three-quarters colourless.

Living: Durban and Kosi Bay (U.C.T.); Delagoa Bay (U.W.).

Distribution. Red Sea, Aden, Mauritius, Indo-Pacific.

Remarks. Cooke gave the number of cusps on the central plate of the radula as 7, but his fig. 6 shows only 5; the outermost one on either side is evidently too minute to show in the figure. Peile said the central plate may have 'one more cusp' (?, i.e. 8). The example here described, from Delagoa Bay, has no median cusp.

Mitra (Strigatella) luctuosa A.Ad.

1844. Reeve. *Conch. Icon.*, fig. 94 (*polita*).
1851. A. Adams. *Proc. Zool. Soc. Lond.*, p. 133.
1880. Von Martens. *Mauritius & Seychellen*, p. 250 and p. 252, pl. 20, fig. 15 (*polita* Rve.).
1919. Cooke. loc. cit., pp. 410, 411 (radula).

Aperture a little shorter than spire. Postnatal whorls 7. Last whorl with 7 spiral punctate grooves (fewer on early whorls), *c.* 12 additional grooves on base, becoming stronger anteriorly. Columella pleats 4. Periostracum thin. 30 × 11 mm. (S. Afr. Mus.).

Chestnut brown, with a pale narrow spiral band a little distance below the suture: between the 3rd and 4th rows of punctae (von Martens: on the 3rd row).

Radula with 81 rows, central plate small, 7-cuspid, outermost cusp on either side very small, lateral plate wide with 7–8 cusps and a long bare margin external to them (Cooke).

Durban (Sowerby, Cooke). Farquhar Island (S. Afr. Mus.).

Mitra (*Scabricola*) *texturata* Lam.

1811. Lamarck. *Ann. Mus. Paris*, xvii, p. 213.
1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 8.
1935. Dautzenberg. *Mem. Mus. R. Hist. Nat. Belg.*, H.S. II, 17, p. 84, pl. 3, fig. 5 coloured (references).

A specimen in S. Afr. Mus. collected by L. E. Kent on the Natal south coast (between Durban and Port Shepstone) confirms Sowerby's record from Durban. It is slightly worn but retains the coloration (cf. Dautzenberg). The species is therefore presumably an inhabitant of South African waters.

Distribution. East Indies, Philippines.

Mitra (*Scabricola*) *crenifera* Lam.

1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 204.
1911. Schepman. *Siboga Exp. monogr.*, xlix, 1, p. 271, pl. 23, fig. 3 (radula).
1936. Peile. loc. cit., p. 143 (radula).

Aperture slightly longer than spire. Protoconch 2 ($2\frac{1}{2}$) whorls, alt. and diam. 0·75 mm., smooth. Postnatal whorls 7, profile slightly and evenly convex. Axial ribs *c.* 20 on 1st and 2nd whorls, 24 on 3rd, increasing to *c.* 60 on 6th, and very numerous on last whorl, especially on back of outer lip, arcuate, separated by narrow grooves, extending across base; crossed by spiral lirae, 3 on 1st and 2nd whorls, 4 on 3rd and 4th, increasing to 10 on last whorl, some of them with a subsidiary narrow lira, *c.* 14 additional lirae on base; sculpture cancellate, formed of small squares on most of the surface, but of axial oblongs on last whorl, mostly smooth but slightly nodulose on base. Columella pleats 4. 42 × 14·5 mm., width of 3rd whorl 2·75–3 mm. (contrast *circula*, *rufescens*).

Cream or buff, with pale orange irregular spots below the suture, lower half of whorl brown with curved retrorse flames projecting upwards, base with a similar brown band with projections, columella glaze with orange margin.

Radula with *c.* 60 rows, central plate about twice as broad as long, with 2 strong cusps flanked by 2 smaller ones on either side, lateral plate $2\frac{1}{2}$ times as broad as long, with 4 strong cusps on inner half, external half of margin bare (Schepman, Peile).

Durban (Sowerby); Delagoa Bay, fresh, presumably living, but no specimen with animal (U.W.).

Off Umhlanga River (Natal), 22–26 fathoms, 1 dead, 18 mm.; off Umkomaas (Natal), 40 fathoms, 1 broken, but with protoconch, 12 mm. (S. Afr. Mus. P.F. coll.).

Distribution. Indian Seas, Philippine Islands, Fiji, Ceylon, Nicobars, Andamans, Mauritius.

Remarks. I am indebted to Mr. A. E. Salisbury for the identification of this species.

The apical whorls increase in width more rapidly than in *circula*, *rufescens*, *acutilirata*.

Mitra '*circulata* Kien. var.'

1919. Cooke. loc. cit., p. 415 (radula).

Radula with *c.* 73 rows, central plate square, with 2 strong cusps flanked on either side by 2 small obscure denticles; lateral plate transversely oblong, with 4–5 cusps (Cooke).

Remarks. The radula described by Cooke from a Durban specimen corresponds so closely with that of *crenifera* that it raises the suspicion that it was extracted from a *crenifera* and not from one of the shells later described as *burnupiana* (see p. 49).

Mitra flammea Q. & G.

1833. Quoy & Gaimard. *Voy. Astrolabe Moll.*, p. 659, pl. 45 *bis*, figs. 23–5 (living animal).
1844. Reeve. *Proc. Zool. Soc. Lond.*, p. 173 (*interlirata*).
1919. Cooke. loc. cit., p. 413, fig. 11 (radula), and p. 414 (*interlirata*) and footnote (synonymy).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 185 (*flammigera*).

Remarks. Smith (1903. *Proc. Mal. Soc.*, v, p. 366) records *flammigera* from 'Kalk Bay (Burnup)'. Some error seems to have occurred, because it is very unlikely that this Indo-Pacific species extends (certainly not living) as far west as Kalk Bay on the east side of the Cape Peninsula. Probably the collector's name (Burnup) should refer to the locality Durban, not to Kalk Bay.

Mitra rufescens A.Ad.

Fig. 12(*b*)

1851. A. Adams. *Proc. Zool. Soc. Lond.*, p. 137.
1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 9 (? if distinct from *circulata* [= *circula*]).

Aperture subequal to spire. Protoconch ? (corroded). Postnatal whorls 7. Spiral lirae 3 on all whorls, but on 6th and 7th a 4th low down and almost concealed in the suture, a weaker intermediary lira between each pair on 5th–7th whorls, and 1–2 striae on last whorl (or the lowermost intermediary

lira may be duplicated); lirae cut by 15–16 narrow axial grooves on 2nd whorl, increasing to *c*. 24 on 5th, and *c*. 50 on last whorl; sculpture cancellate with squares on early whorls and axial oblongs on later whorls, but spiral lirae predominant. Columella pleats 3, sometimes a feeble 4th. 26 × 9 mm., width of 3rd whorl 1·5–1·75 mm.

Buff, more or less rufescent, possibly due to staining (iron stanchions, etc., in Durban harbour).

Durban (Sowerby; also S. Afr. Mus. ex coll. Ross-Frames, fresh, presumably living).

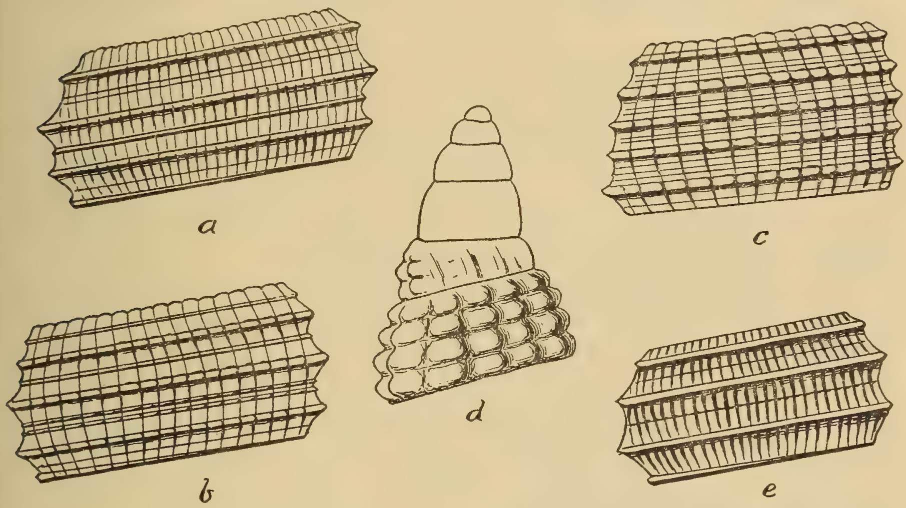


FIG. 12.

One whorl (semi-diagrammatic) of (*a*) *Mitra circula* Kien.; (*b*) *M. rufescens* A. Ad.; (*c*) *M. acutilirata* Sow.; (*e*) *M. foveolata* Dnkr.; (*d*) protoconch and first two postnatal whorls of *M. acutilirata* Sow.

Mitra acutilirata Sow.

Fig. 12(*c*), (*d*)

1874. Sowerby. *Thes. Conch.*, iv, sp. 129, pl. 15, figs. 273, 274.
1936. Peile. loc. cit., p. 142 (radula).

Aperture subequal to spire. Protoconch 4 whorls, somewhat lopsided, alt. 0·8, diam 0·6 mm., smooth. Postnatal whorls 8. Spiral lirae 3 at start of 1st whorl, 4 on each of 2nd–6th whorls, 5 on 7th and 8th whorls, 7–8 additional lirae on base; these main lirae rather sharply subcarinate, between them 1–3 striae and sometimes a weaker intermediary subcarinate lira on last whorl; lirae cut by 13–14 narrow axial grooves on 2nd whorl, increasing to *c*. 22 on 5th and 45–50 on last whorl; sculpture cancellate with small squares and axial oblongs. Columella pleats 4, the lowermost one feeble. 26 × 9 mm., width of 3rd whorl 1·5–1·75 mm.

Dull greyish, a brownish band around middle of body whorl, with some irregular flame-like expansions above (cf. *crenifera*), the main lirae with small brown spots on their crests.

Radula of the *Mitra* (s.s.) form, central plate with *c.* 10 cusps, lateral plate very wide, with cusps throughout its width (Peile).

Delagoa Bay, 1 juv. (S. Afr. Mus. coll. K.H.B. 1912); same locality, 3 (U.W.).

Distribution. Farquhar Island (S. Afr. Mus. coll. E. L. Layard, on board H.M.S. *Castor*, 1856); Mauritius, Indo-Pacific.

Remarks. I am indebted to Mr. A. E. Salisbury for the identification of this species.

A Philippine specimen 37 × 13 mm. (S. Afr. Mus. ex coll. Ross-Frames) named *scabriuscula* Linn. (by Sowerby & Fulton) agrees with the above description except there are 5 main lirae on 5th whorl, 6–7 on 6th, 7–8 on 7th whorl. The increase of the intermediary lirae to become main lirae is scarcely of specific importance; but I am not able to decide the validity of Sowerby's species, and accept Mr. Salisbury's identification. Neither *scabriuscula* nor *acutilirata* has hitherto been recorded from South Africa.

Three dead juveniles from off O'Neil Peak (Zululand), 90 fathoms (S. Afr. Mus. no. A8811. P.F. coll.) may be this species, but the axial grooves are more numerous than in the other specimens at hand.

Mitra (*Cancilla*) *circula* Kien.

Fig. 12(*a*)

1839. Kiener. *Spec. Coq. Mitra*, p. 21.
1919. Cooke. loc. cit., p. 417 (radula).
1921. id. *Proc. Mal. Soc.*, xiv, p. 114, fig. 2 (*burnupiana*).
1936. Peile. loc. cit., p. 143, fig. 9 (radula).

Aperture subequal to spire. Protoconch $3\frac{1}{2}$ whorls, diam. 0·6, alt. 0·75 mm. Postnatal whorls 8. Spiral lirae 3 on each whorl, from 4th or 5th onwards a 4th lira low down and partly concealed in the suture, 1–3 striae and sometimes a subsidiary lira above 1st lira, 1–2 striae between each pair of main lirae and sometimes 2 lirae between 3rd and 4th lirae, 7 (8) additional lirae on base, with intermediaries; lirae cut or nicked by numerous close-set axial striae, 15–16 on 1st whorl, 19–20 on 2nd, increasing to at least 60 on 7th and more on 8th whorl; sculpture cancellate with small squares and axial oblongs, lirae predominant. Columella pleats 3 with an obscure 4th. 31·5 × 10 mm., width of 3rd whorl 1·75–2 mm.

White or buff, lower half of whorls faintly orange.

Radula with arcuate central plate, lateral plate transversely elongate, both plates with numerous denticles or cusps (Cooke, Peile).

Inner harbour, Durban (S. Afr. Mus. coll. Ross-Frames); Cape Natal, 54 fathoms, 1 broken apex (S. Afr. Mus. P.F. coll.); Delagoa Bay (U.W.).

Remarks. Except for the development of more numerous axial striae, there seems little difference between the specimens here referred to *circula* and those referred to *rufescens*.

The status of the name *burnupiana* depends on the shell alone, because the description was based on the shell and was accompanied by a figure (albeit diagrammatic). It is here treated as a synonym.

The distinctions (Cooke, 1921) between *circula* and *burnupiana*, both found together in Durban Bay, are not very convincing. Plump and slender individuals occur in many Gastropods. The incidence of the line joining the columella pleats (see Burnup's diagram in Cooke, 1921) depends on the angle from which the shell is viewed, and in any case may be vitiated by a very slight curvature in the columella, or the variable development of the pleats.

It seems most unlikely that there should be two species living together which are scarcely distinguishable conchologically, but which have quite dissimilar radulae (see p. 45, *crenifera*).

Mitra foveolata Dnkr.

Fig. 12(*e*)

1863. Dunker. *Novitat. Conch.*, p. 46, pl. 15, figs. 5, 6.

Fusiform. Spire 1¼ in aperture. Protoconch ? 3 whorls (broken). Postnatal whorls 8. Spiral lirae 3 on each whorl, from 4th onwards a 4th lira low down and partly concealed in the suture, an impressed stria (sometimes two striae) between each pair of lirae, between 3rd and 4th lirae a weak intermediary lira, *c*. 10 additional main lirae on base, sometimes with intermediaries between the upper 6 or 7 lirae; lirae cariniform, uninterrupted; between the lirae close-set axial striae, often subfoveolate underneath each lira. Suture slightly canaliculate. Columella pleats 4, the 4th feeble, but sometimes a feebler 5th pleat. 25 × 9–10 mm.

Pale buff (sometimes stained orange-rufous) with irregular orange-brown axial streaks or flames.

Durban (S. Afr. Mus. ex coll. Ross-Frames); Delagoa Bay (S. Afr. Mus. coll. K.H.B., 1912).

Remarks. The identification of this species also I owe to Mr. Salisbury.

The continuous carinate lirae, not cut by the axial striae, distinguishes the species from the others here recorded as *acutilirata*, *rufescens*, *circula*. Watson's figure of *rufescens*, however (1886. *Challenger Rep.*, xv, pl. 14, fig. 5), shows a similar sculpture.

Von Martens in 1880 (*Mauritius & Seychellen*, p. 251) gave this species as a synonym of *interlirata* Rve. 1844, and in 1903 (*D. Tiefsee Exp.*, vii, p. 106) as a synonym of *flammigera* Rve.

Mitra (*Swainsonia*) *ocellata* (Swains.)

1831. Swainson. *Zool. Illustr.* (2), ii, pl. 54 (*Mitrella o.*).
1854. H. & A. Adams. *Gen. Rec. Moll.*, i, p. 180 (*Swainsonia o.*).

Fusiform. Aperture slightly longer than spire. Protoconch broken. Postnatal whorls 7. Spiral punctate striae 3 on 1st whorl, 4 on 2nd, increasing to 5 on last whorl, 9 additional striae on base, not becoming stronger anteriorly; fine close-set axial growth-lines. Columella pleats 5; a narrow parietal callus from top of aperture to 1st pleat; outer lip slightly thickened. 27 × 9·5 mm.

Pale fawn with irregular white marks which are flame-like on upper whorls, then breaking up into arrows and triangles, resembling on the body whorl the pattern of a 'textile' cone.

Natal (S. Afr. Mus. received from a private collector, the locality therefore not certain; also a worn specimen from the coast between Durban and Port Shepstone collected by L. Kent).

Distribution. East coast of Africa, Singapore.

Remarks. The shell is apparently not much worn although highly polished. The body whorl has three times suffered injury and been repaired; this may account for the 5th columella pleat (though 5 pleats is usual in *Swainsonia*); at two of the breaks the outer lip shows a slight narrow thickening before the continuation of growth.

M. fissurata Lam., of which *ocellata* has been considered a variety (Tryon. Man. Conch.) occurs at Mauritius and Seychelles (1880. Von Martens. *Maurit. & Seych.*, p. 249); *ocellata* is dintinguished by the punctate-striate sculpturing (A. E. Salisbury in litt. 1957).

Mitra (*Callithea*) *subulata* (Lam.)

Fig. 13(*a*)

1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 211.
1859. Chenu. *Man. Conchyl.*, i, fig. 1019.

Slender, fusiform, profile of spire straight. 6 whorls preserved (protoconch and ? 2 whorls missing). First 4 preserved whorls each with 4 spiral striae; 5th whorl with 6, 6th with 2 plus 4 (or 5) indistinct striae. On the 4th, 5th and 6th whorls the uppermost stria is better developed than the others, forming a *Terebra*-like groove. Indications of numerous low rounded, close-set axial ribs on last 2 or 3 whorls, more distinct above the spiral groove than below it, and making the suture undulate or crenulate. 16 or 17 additional striae on base, becoming stronger anteriorly. Columella pleats 4. 25·5 × 8 mm., aperture 12 mm.

Off O'Neil Peak (Zululand), 90 fathoms, one dead and partly corroded (S. Afr. Mus. no. A8763. P.F. coll.).

Remarks. Somewhat similar in shape to *picta* and *aerumnosa*, but the distinctive feature is the *Terebra*-like spiral groove.

Mitra (*Dibaphus*) *bathybius* n. sp.

Figs. 11(*c*), 13(*b*)

Protoconch 2 whorls, alt. 1, diam. of 1st whorl 1, of 2nd whorl 1·5 mm., smooth. Postnatal whorls 4 (preserved), with cancellate sculpture; 1st whorl at beginning with close-set axial riblets (some of which may belong to the protoconch), later with in addition 4 spiral striae; arcuate axial ribs *c.* 20. on 1st whorl, 20 on 2nd, 23 on 3rd, and 25 on 4th whorl, distinct and sharp on first three whorls, becoming feeble on 4th and indistinct towards outer lip; spiral striae 5 on 2nd, 6 on 3rd, 7 on 4th whorl, crossing the ribs, broader and deeper (almost grooves) on upper part of whorl than on lower part; 10 additional grooves on base (*c.* 20 including those on rostrum). No columella pleats. No operculum.

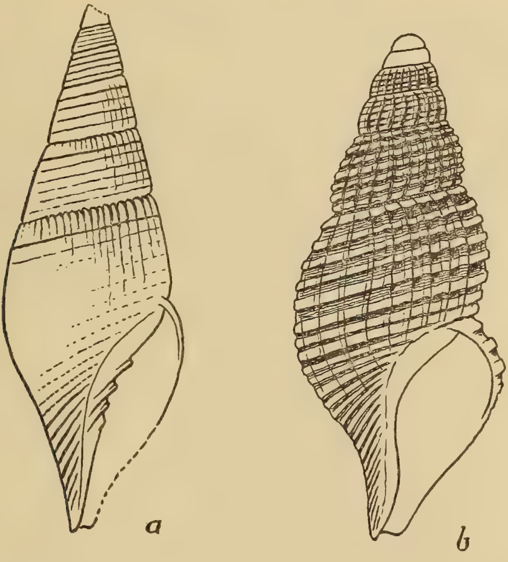


FIG. 13.
(*a*) *Mitra* (*Callithea*) *subulata* Lam. (*b*) *Mitra* (*Dibaphus*) *bathybius* n. sp.

Radula with 60 rows, central plate with 5 cusps, a tiny cusp or denticle at side not traceable, lateral plate with 10 cusps, a small one at inner end, followed by 3 large ones, the other 6 farther apart and decreasing in size.

Off Cape Natal, 440 fathoms, 1 alive and one fragment (S. Afr. Mus. A8827. P.F. coll.).

Remarks. Very fortunately this shell, although preserved dry for 57 years in a bottom-sample, contained a well-preserved animal; presumably the sample had originally been preserved in formalin. Owing to the likeness of the shell to Tomlin's description and figure of *Charitodoron pasithea* (p. 146) it was unexpected to find the animal possessed a Mitrid radula.

The radula resembles that of *M.* (*Dibaphus*) *edentula* (see: Cooke 1919); the shell, however, is very different in appearance from that of *edentula*.

It seems safer not to include the genus *Charitodoron* in the *Mitridae*, but to wait until the radula of an undoubted species of this genus has been obtained.

Gen. Vexillum Bolten-Röding

(syn: *Turricula* Klein)

Fusiform or turriform. Radula with arcuate, multicuspid central plate, and simple falcate lateral plate.

Vexillum alauda (Sow.)

1874. Sowerby. *Thes. Conch.*, iv, pl. 361, figs. 134, 135.
1903. Smith. *Proc. Mal. Soc.*, v, p. 367.
1919. Cooke. loc. cit., p. 418 (radula).

Narrow fusiform. Aperture a little shorter than spire. Protoconch ? Postnatal whorls 9. Axial ribs 14–15 on 1st whorl, 16–17 on 2nd, from the 5th or 6th whorl decreasing to 13 on the last whorl, thin, straight, slightly shouldered on body whorl, descending to base, not crossed by spiral striae; spiral striae 3–4 on 1st and 2nd whorls, increasing to 6–7 on last whorl, some of them double, *c.* 15 additional ones on base becoming grooves anteriorly; well impressed on early whorls, but becoming feebly so on later whorls. Columella pleats 4. Outer lip feebly plicate internally. 40 (protoconch and 3 whorls missing) × 13 mm.

Fawn or grey, upper half of whorls with a brown band, bordered below by a narrow line, a second brown band at bottom of whorl partly concealed in suture, but clear on body whorl as far as outer lip, base anteriorly brownish; half-grown specimens chestnut brown, with or without the pale yellowish line; some specimens bluish-grey with two series of orange-brown spots on the ribs.

Radula, central plate with 16–17 denticles (Cooke).

Durban (Smith; and S. Afr. Mus); Inhambane, Portuguese East Africa (U.C.T.).

Distribution. Mauritius.

Remarks. The specimens from the Morrumbene estuary, Inhambane, are discoloured and corroded, but one retains the two series of brown spots on the ribs.

Vexillum exasperatum (Gmelin)

1790. Gmelin in *Linn. Syst. Nat.*, ed. 13, i, p. 3453 (*Voluta e.*).
1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 219 (*arenosa*).
1911. Schepman. *Siboga Exp. monogr.*, xlix, 1, p. 287 (*torulosa* as synonym, *arenosa* as variety).
1919. Cooke. loc. cit., p. 418, fig. 17 (radula), and p. 418 (*arenosa*).
1935. Dautzenberg. loc. cit., p. 148 (with vars. *torulosa* and *arenosa*) (references).
1936. Peile. loc. cit., p. 143, fig. 10 (radula).

Cooke figured the central plate of the radula of *exasperatum* with 15–16 denticles; Peile's figure shows 19 cusps, the median one the largest; and Cooke gave 20–22 denticles for *arenosum*.

Durban (Sowerby); Delagoa Bay (U.W.); Mozambique Island (S. Afr. Mus. coll. K.H.B. 1912).

Distribution. Red Sea, East Africa, Indo-Pacific.

Remarks. Two broken specimens were identified by Tomlin as *arenosa*. They do not exactly correspond with specimens from New Caledonia identified as this species by Sowerby & Fulton.

Vexillum torulosum (Lam.)

1811. Lamarck. *Ann. Mus. H. N. Paris*, xvii, p. 216.
1859. Chenu. *Man. Conchyl.*, i, fig. 1014.

Turreted. Aperture a little shorter than spire. Protoconch ? Postnatal whorls 6 (? 7), profile angularly shouldered. Axial ribs 15 on the apical two whorls (probably the 2nd and 3rd), decreasing to 11 on last (6th or 7th) as wide as intervals on early whorls, much narrower on later whorls, extending across base; crossed by 2 spiral striae on early whorls, increasing to 4 on 4th (? 5th) and 12 (5 above, 7 below shoulder) on last whorl, 10 additional striae on base before the costate rostrum which has 3–4 lirae; growth-lines increasing in strength and forming a cancellate sculpture on later whorls. Columella pleats 4. 22 (apex missing) × 11·5 mm.

Uniform dull fawn.

Delagoa Bay, one dead but fresh (U.W.).

Remarks. The specimen corresponds with Chenu's figure, and is quite distinct from the specimens identified by Tomlin as *arenosum*.

Vexillum daedalum (Rve.)

Fig. 14(*a*)

1845. Reeve. *Proc. Zool. Soc. Lond.*, p. 54; and *Conch. Icon.*, Mitra, pl. 34, fig. 281.
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 227.
1911. Schepman. *Siboga Exp. monogr.*, xlix, 1, p. 285.

Aperture $1\frac{1}{3}$ in spire. Protoconch broken. Postnatal whorls 8, sutures deep but not canaliculate. Axial ribs 11 on 1st whorl, increasing to 15–17 on last whorl, moderately sharp, extending across base, intervals bluntly V-shaped; spiral grooves in the intervals 5 on 2nd whorl, increasing to 7 on last whorl, 8–9 additional grooves on base, deeply impressed in the intervals but not crossing the ribs except on lower part of base where they cause the ribs to be slightly nodulose. Columella pleats 4; a nodular parietal callus at top of aperture. Outer lip plicate within. 19 × 7 mm.

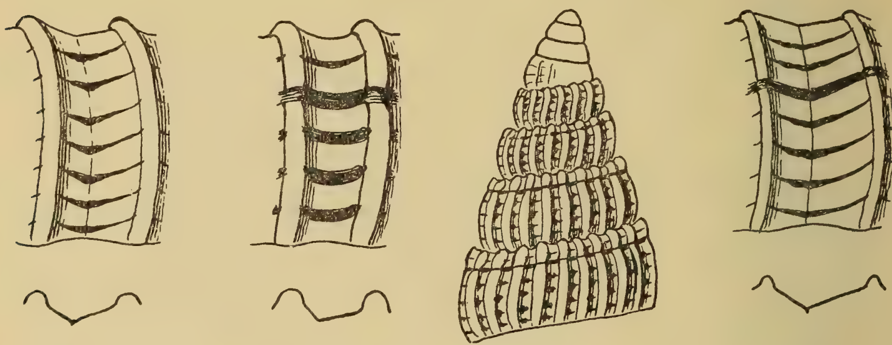
Pale orange-brown (probably faded), a white band at top of whorl (below the suture) and another at bottom of whorl (above suture), and one or two on base of body whorl.

Off Scottburgh (Natal), 92 fathoms, dead shells (Sowerby).

Off Umhlangakulu River (Natal), 50 fathoms, 2 dead (seen by Sowerby); off O'Neil Peak (Zululand), 55 fathoms, 2 dead (S. Afr. Mus. P.F. coll.).

Distribution. Philippine Islands, East Indies.

Remarks. Having no authentic *daedalum* for comparison, I accept Sowerby's identification of two Natal examples (S. Afr. Mus. no. A3482), returned by him but from a locality different from that which he recorded (1903). He did not state the number of P.F. specimens received by him. One wonders whether perhaps the two specimens included in a collection 'from South Africa' in the United States National Museum, and described by Bartsch as *helena*, were P.F. specimens (see p. 55).



a *b* *c* *d*

Fig. 14.

Sculpture (semi-diagrammatic) of (*a*) *Vexillum daedalum* (Rve.); (*b*) *V. sculptile* (Rve.); (*d*) *V. discoloria* (Rve.); (*c*) protoconch and first four postnatal whorls of *Vexillum* sp. (S. Afr. Mus. no. A8813).

An axial stria is sometimes present at the bottom of the V-shaped intervals; and the V is not always symmetrical, the bottom being nearer to the following rib than to the preceding rib. cf. *discoloria*.

Vexillum sculptile (Rve.)

Figs. 11(*d*), 14(*b*)

1845. Reeve. *Proc. Zool. Soc. Lond.*, p. 55; and *Conch. Icon.*, Mitra, pl. 35, fig. 290.
1874. Sowerby. *Thes. Conch.*, iv, Mitra, p. 34, pl. 26, fig. 596.
1886. Watson. *Challenger Rep.*, xv, p. 251.
1911. Schepman. *Siboga Exp. monogr.*, xlix, 1, p. 286.

Seven specimens from Delagoa Bay differ in the following respects. Aperture $1\frac{1}{4}$ in spire. Postnatal whorls 8–9. Axial ribs 15–16 on 1st whorl, increasing to 26–30 on last whorl, not very sharp, extending across base, intervals more or less V-shaped, narrower than in *daedalum*; spiral grooves in the intervals 4 on 2nd whorl, increasing to 5 (6) on last whorl, 8–9 additional

grooves on base, deeply impressed in the intervals (in the largest specimen, which has 30 ribs, they are more like pits than grooves), not crossing the ribs except on lower part of base where the ribs are slightly nodulose; the 2nd groove from the top of whorl is the deepest, usually cutting the ribs and forming, especially on the early whorls, a *Terebra*-like continuous spiral groove. Columella pleats 4; a nodular parietal callus at top of aperture. Outer lip plicate within. 21 × 7 mm.

Upper half of whorls more or less brown, lower half cream, base brown.

Radula (only one available) with 55 rows, central plate concave in front, with 13 cusps between the acute postero-lateral angles, lateral plate falcate. Two of the cusps on the central plate often united to form a single apically bifid cusp, the fusion not occurring on every plate, and not in the same position.

Inhaca Island, Delagoa Bay, 2 living and 5 dead (S. Afr. Mus. coll. K.H.B. 1912).

Distribution. East Indies, Philippine Islands.

Remarks. Bartsch (1915. *Bull. U.S. Nat. Mus.*, 91, p. 43) described *Mitra helena* based on two specimens from 'South Africa', originally sold by Sowerby & Fulton as *daedalum.* Bartsch said *helena* (15 × 6·6 mm.) was smaller (how much smaller?) than the Philippine *daedalum.* The description gave the numbers of axial ribs as 16 on 1st whorl, 20 on 2nd, and 16 [*sic*] on the last; if 16 is a typ. err. for 26, the numbers correspond with those of the Delagoa Bay specimens better than with those of the specimens here recorded as *daedalum.*

Vexillum sp.

Fig. 14(*c*)

A single specimen in fresh condition taken off Cape Natal (Durban), 54 fathoms (S. Afr. Mus. no. A8813. P.F. coll.) is closely allied to *daedalum*, and may be referable to *sculptile*, but is much more slender.

Narrow fusiform. Aperture $1\frac{1}{2}$ in spire. Protoconch $3\frac{1}{2}$ whorls, slightly lopsided, alt. 0·75, diam. 0·5 mm., smooth. Postnatal whorls $7\frac{1}{2}$. Sutures deep, but not canaliculate. Axial ribs 11–12 on 1st whorl, increasing to *c.* 22 on 4th and *c.* 33 on last whorl, subequal in width to the intervals, extending across base; spiral striae 3–4 on 1st whorl, from 2nd whorl onwards the uppermost stria becomes groove-like, more deeply impressed, and cuts the ribs, followed by 4 striae, forming rather deep pits in the intervals but scarcely cutting the ribs; from 4th whorl onwards an additional feeble stria is developed between the suture and the deeply impressed stria; 7 additional striae on base. Columella pleats 4; a feeble nodular parietal callus at top of aperture. Outer lip plicate within. 15 × 4·5 mm. (probably not quite fully grown).

White, a very faint trace of a yellowish band below suture and another on lower part of base of body whorl.

Vexillum discoloria (Rve.)

Fig. 14(*d*)

1845. Reeve. *Proc. Zool. Soc. Lond.*, p. 46; and *Conch. Icon.*, Mitra, pl. 29, fig. 230.
1880. Von Martens. *Mauritius & Seychellen*, p. 255 (*discolor* [*sic*]).

Two P.F. specimens were identified by Sowerby as this species, but the record was not published.

Fusiform; aperture $1\frac{1}{3}$–$1\frac{1}{2}$ in spire. Protoconch broken. Postnatal whorls 7. Sutures deep but not canaliculate. Axial ribs 11 on 1st whorl, increasing to 15–16 on last whorl, rather sharp, much narrower than the more or less V-shaped intervals, extending across base; a fine axial stria along the bottom of the intervals, which is sometimes asymmetrical (cf. *daedalum*); spiral striae 5 on 2nd whorl, 7 on last whorl, *c.* 14 additional striae on base, strongly marked in the intervals, not cutting the ribs except on base where the intersected ribs are slightly nodulose; on 1st–3rd whorls the stria next the suture is the deepest, at 4th whorl a weaker stria is interpolated, and on 5th and 6th whorl 2 striae; thus the 1st, then the 2nd, and ultimately the 3rd stria is the strongest and most deeply impressed, forming a *Terebra*-like spiral groove, especially noticeable on the early whorls. Columella pleats 3, with an obscure 4th anteriorly. Outer lip plicate within. 12·5 × 4·5 mm.

Pale brown, slightly darker in the intervals, with a white band around *middle* of whorl, and two other bands on the base.

Off Umvoti River (Natal), 27 fathoms, 2 dead but fresh (S. Afr. Mus. P.F. coll.).

Distribution. Mauritius, Réunion (von Martens).

Remarks. Reeve's description (I have not seen his figure) does not quite fit the present specimens except as regards the colour: 'fasciis roseis et albis alternata, fasciis roseis inter costas ustulato-nigricantibus'.

Vexillum capense (Rve.)

Fig. 11(*e*)

1845. Reeve. *Conch. Icon.*, Mitra, pl. 33, fig. 268.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 53 (listed) (*Turricula* (*Pusia*) *c.*).
1910. Schwarz. *Tr. Geol. Soc. S. Afr.*, xii, p. 115.
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 44, pl. 21, fig. 4 (*ima*).
1932. Turton. *Mar. Sh. Port Alfred*, p. 47, pl. 10, no. 354; and p. 47 (*ima*).
1932. id. ibid., p. 48, pl. xi, no. 356 (*albanyana*).
1932. id. ibid., p. 48, pl. xi, no. 357 (*hera*).

Aperture a little shorter than spire. Protoconch $1\frac{1}{2}$ whorls, alt. 0·5, diam. 0·6–0·7 mm., smooth. Postnatal whorls 5. Axial ribs 11–12 on 1st and 2nd whorls, 14–15 on body whorl, narrower than the intervals (in fresh specimens), extending across base (in fresh specimens); spiral striae in the intervals 7 (8–9), not crossing the ribs, often not conspicuous, 11–12 additional striae on base,

but usually only the 5–6 stronger anterior ones conspicuous. Columella pleats 4. 11·5 × 5 mm. (Turton: 15 mm. long.).

Pale fawn, with a darker orange-brown band, sometimes mottled, above a white peripheral band, base orange-brown more or less spotted with white; the white band is usually suffused in the middle so that an upper and a lower band of pure white is formed; the axial grooves also are often suffused, which produces a 'necklace' effect of white spots on the ribs, and the upper necklace is bordered below by a narrow brown line (cf. Bartsch's figure of *ima*).

Radula, one specimen examined but presumably incomplete because only 20 rows were obtained, central plate strongly arcuate in front, with 13 cusps between the acute postero-lateral angles, lateral plate falcate.

Fossil: Pleistocene, Port Elizabeth (Schwarz).

Living: False Bay (U.C.T.).

Dead: Kalk Bay (False Bay) to Port Alfred (auct. et S. Afr. Mus.); Tongaat (30 miles north of Durban) (S. Afr. Mus.); Still Bay (U.C.T.).

Off Nanquas Peak (eastern part of Algoa Bay), 63 fathoms, 3 dead; off Cove Rock (East London), 22 fathoms, 1 juv. (S. Afr. Mus. P.F. coll.).

Remarks. Although Dunker is quoted as author by Krauss, Sowerby (1892), Bartsch, and Turton, the species should be credited to Reeve (see Sherborn. *Index Anim.*).

Neither Bartsch nor Turton seems to have realized that *ima* is merely a worn specimen of *capensis*. Among a large number of beach-worn specimens two or three can usually be found which have reached the right stage of abrasion. The same applies to *albanyana* and *hera*.

Under *capensis* Turton (p. 47) mentions *rufocincta* Adams 1851 as a 'variety (or synonym)'; see *euzonata* (p. 38).

Sometimes only 4 or 5 well-spaced spiral striae are visible in the intervals, e.g. the 3 P.F. specimens, and one out of about 50 specimens from Still Bay (S. Afr. Mus.). A similar reduction in the number of spiral striae occurs in a specimen of *eucosmia* Turton = *kowieensis* (p. 39).

Gen. Pusia Swainson

Fusiform. Radula with arcuate, tricuspid central plate, and simple falcate lateral plate.

Pusia patula (Rve.)

Fig. 11(*f*)

? 1840. Küster in *Mart. Chemn. Syst. Conch. Cab.*, p. 108, pl. 17*a*, figs. 4–6 (*pruinosa*) (*fide* von Martens, 1903).
? 1845. Reeve. *Proc. Zool. Soc. Lond.*, p. 49; (*M. pica*) and *Conch. Icon.*, Mitra, pl. 31, fig. 247.
1845. id. ibid., p. 61; and ibid., pl. 39, fig. 333 (*M. patula*).
1846. Dunker. *Zeitschr. Mal.*, iii, p. 111 (*simplex*).
1848. Krauss. *Südafrik. Moll.*, p. 125, pl. 6, fig. 20 (*simplex*).
1889. Sowerby. *J. Conch.*, vi, p. 8, pl. 1, fig. 11 (*merula*).
1903. Smith. *Proc. Mal. Soc.*, v, p. 366 (*pica* and *patula*).

? 1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 31 (*simplex*, ? non Dnkr.).
1906. Smith. *Ann. Natal Mus.*, i, p. 33 (*simplex*; removes the Tasmanian *cinnamomea* from the synonymy).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 45 (*merula, simplex* and *patula*).
1916. Sowerby. *Ann. Mag. Nat. Hist.* (8), xviii, p. 491, text-fig. (*fidis*).
1922. Peile. *Proc. Mal. Soc.*, xv, p. 94, fig. 4 (radula) (*merula*).
? 1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 185, pl. 32 (20), fig. 22 (? *simplex*, disagrees with von Martens 1903).
1925. id. ibid., p. 186, pl. 32 (20), fig. 24 (*hottentota*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 45 (*merula*); p. 45, pl. 10, no 337 (*lurida*); p. 45, pl. 10, no. 338 (*fidis*); p. 46 (*patula, pica* and *simplex*); p. 46, pl. 10, no. 340 (*simplex* var. *alfredensis*).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 100, fig. 37 (radula) (*patula*).

Ovate-fusiform. Aperture about $1\frac{1}{3}$ times the spire. Protoconch 2 whorls, alt. and diam. 0·5 mm., smooth. Postnatal whorls 6–7. First whorl at start with some fine axial pliculae, following whorls smooth, feebly or distinctly ribbed, when present 12–14 ribs on 4th and 15–18 on last whorl; fine spiral striae 3 on 1st whorl, increasing to 5 or 6 on upper part of whorls, minutely crinkly (due to growth-lines) if whorls smooth, visible only in the intervals when the whorls are ribbed; usually no striae visible on periphery, but 4–5 may appear on lower half of whorls; in fresh examples the striae probably cross the ribs; on base 15–18 additional striae, usually visible only on lower part where they separate *c.* 10 lirae. Columella pleats 4. 17·5 (apex worn) × 6·5 mm.

Various shades of brown, sometimes very dark, almost black, often with a white mark on outer side of outer lip, or with a white interrupted spiral band in middle of whorl; some specimens mottled.

Radula with *c.* 70 (Peile: 64–67) rows, central plate arcuate, tricuspid, lateral plate falciform. The shape of the lateral plate seems to vary; my examples are intermediate between Peile's figures of *merula* (1922) and *patula* (1938).

From Durban along the south coast and around the Cape Peninsula up to Port Nolloth on west coast.

35° 16′ S. 22° 26′ E., 155 metres (Thiele: *hottentota*).

Remarks. *M. pruinosa* is listed above on the authority of von Martens (1903). *M. pica* was described from an unknown habitat, but listed as South African by Smith (1903), and Turton, though the latter did not claim to have found any at Port Alfred. I have seen no specimens with a 'jagged white band' encircling the black whorls '*next the sutures*' (Reeve, italics mine). A white band is frequently present in the *middle* (or slightly above) of the whorl, and may be almost continuous, or divided into a series of spots, or it may appear as a white mark only on the outer lip.

Peile (1922) remarks that though *ebenus* (to which Sowerby likened his *merula*) has a smooth shell, its var. *savignyi* is costulate; *merula* is 'slightly costulate'. This lends support to the present contention that only one species is found in South Africa.

The references to von Martens and Thiele are included with queries. Thiele disagreed with von Martens's identification, but left the specimens *sub judice*; his figure strongly suggests that the dead and bleached *Valdivia* specimens were really *aerumnosa* (q.v. p. 41).

Turton's *simplex* var. *alfredensis* appears to be merely a redescription of Reeve's *patula*: 'cinerea, fusco hic illic variegata et nebulata' (Reeve), 'a light mottled variety showing various colours' (Turton).

Peile's specimens of *merula* (Durban) and *patula* (East London) were both supplied by Tomlin, who presumably favoured the recognition of two species. Their radulae scarcely differ sufficiently to indicate two species; especially as my examples are intermediate in shape.

I consider therefore that only one species, common around the whole South African coast from Durban to Port Nolloth, should be recognized; but I am not in a position to decide whether *pica*, having page precedence, should replace *patula*, or whether the earlier *pruinosa* should be accepted.

The *Pieter Faure* obtained no examples except one very slender shell off Cape Morgan, 47 fathoms (S. Afr. Mus. no. A8812. P.F. coll.). Pale brown. Four whorls, 8 × 3 mm. (a normal 4-whorled example is 7·5 × 3·3–3·5 mm.). 13 ribs on last whorl; 13–14 spiral striae on last whorl, those nearest the suture closer together than the others, as in normal examples.

Gen. Imbricaria Schumacher

Biconical. Radula as in typical *Mitra*.

Imbricaria carbonacea Hinds

1844. Hinds. *Zool. Voy. Sulphur.*, p. 41, pl. xi, figs. 9, 10.
1910. Dautzenberg. *Act. Soc. Linn. Bordeaux*, p. 47.
1912. id. *Ann. Inst. oceanogr.*, V, fasc. 3, p. 28.

Smooth, polished, with obscure grooves on base; columella pleats 5, the lower ones obscure. Size not stated: Hinds's figure 22 × 11 mm. Black, aperture internally pale.

Baie de Rufisque (Dakar, West Africa), 18–20 metres (Dautzenberg 1910); Mossamedes, 15–20 metres (Dautzenberg 1912).

Remarks. Described by Hinds from deep water on the Agulhas Bank, but it has not since been recorded from South African waters. Probably some error occurred in labelling Hinds's material, as Belcher (in command of the *Sulphur*) is known to have relied upon his memory.

Fam. *OLIVIDAE*

1929. Thiele. *Handbuch*, i, p. 330.

On account of its radula Thiele included *Melapium* in this family, although the shape of the shell is very different from that of any of the other genera.

Thiele (p. 332) created the genus *Zemiropsis* for *Eburna* (i.e. *Babylonia*) *papillaris* Sow., stating that the systematic position was doubtful in the absence of knowledge of the operculum and animal. He evidently overlooked Sowerby's figure (1902. *Mar. Invest. S. Afr.*, ii, pl. 2, fig. 3); and moreover gave no *conchological* reasons for instituting a new genus or for including it in the *Olividae*. In fact this species is a true *Babylonia* (p. 147).

Gen. Oliva Brug.

The *Pieter Faure* obtained one very worn *ispidula* Linn. from Morewood Cove (between Umhloti and Umvoti, Natal), 27 fathoms; one living *dactyliola* Duclos 1835 from off Tugela River, 14 fathoms; and one dead *dactyliola* from off Umkomaas, 13 fathoms (the first two identified by Sowerby 3rd).

Braga (1952. *Anais J. Invest. Ultramar.*, vii, 3, p. 71) records *inflata* Lam. 1811 (= *bulbosa* Bolten 1798) from Delagoa Bay; and *brasiliensis* Chemn. (!) from Mozambique. Macnae & Kalk (1958. *Nat. Hist. Inhaca Is.*, p. 128) add *elegans* Lam. and *scitula* Marrat from Delagoa Bay.

Gen. Sylvanocochlis Melvill

1889. (Melvill) in Sowerby, *J. Conch.*, vi, p. 149 (subgen. *Mariona*, non Vayssière 1879).
1903. Melvill. ibid., x, p. 325.

Shell ovate-fusiform, with thick walls. Columella concave, with parietal callus constricting the posterior end of aperture, separated from outer lip by a narrow slit, which is accentuated by the slight depression on last whorl forming an indent in the outer lip. Canal short, wide. Last whorl with a spiral groove near base forming a denticle on outer lip.

Operculum horny, large, oval, nucleus apical.

Radula with not very broad, tricuspid central plate, and bicuspid lateral plate (as in *Pseudoliva*).

A monotypic, indigenous genus, if maintained distinct from *Pseudoliva*.

Sylvanocochlis ancilla (Hanley)

Fig. 15(*a*)

1859. Hanley. *Proc. Zool. Soc. Lond.*, p. 429 (*Pseudoliva a.*).
1889. Sowerby. loc. cit., p. 149, pl. 3, fig. 2 (*Pseudoliva a.*).
1892. id. *Mar. Sh. S. Afr.*, p. 15, pl. 1, fig. 14 (*Pseudoliva a.*) (this figure, reproduced from the 1889 figure, does not show the characteristic posterior slit in the aperture).
1903 (1 July). Melvill. loc. cit., p. 324, fig.
1903 (8 July). Sowerby. *Mar. Invest. S. Afr.*, ii, p. 228 (*Pseudoliva a.*).
1904. Smith. *J. Malac.*, xi, p. 23 (*Sylvanocochlea*, err.).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 35 (*Sylvanocochlea*, err.).
1931. Tomlin. *Ann. Natal Mus.*, vi, p. 430.
1932. Turton. *Mar. Sh. Port Alfred*, p. 33 (? and pl. 7, no. 246).

Aperture $1\frac{1}{2}$–$1\frac{2}{3}$ times the spire. Protoconch $1\frac{1}{2}$ whorls, alt. 1·5, diam. 2 mm., smooth (but worn). Postnatal whorls 4. Periostracum thick, forming close axial wrinkles, the free margins of which are minutely fimbriate.

Operculum slightly convex, 23×12 mm. in 51 mm. shell.

Fulvous or slightly pinkish or violaceous, periostracum dull brown, operculum dark brown. Animal pale, sprinkled with black specks around margin of foot, siphon closely ringed with black.

Radula (of Algoa Bay specimen) with 57 rows, fig. 15(*a*).

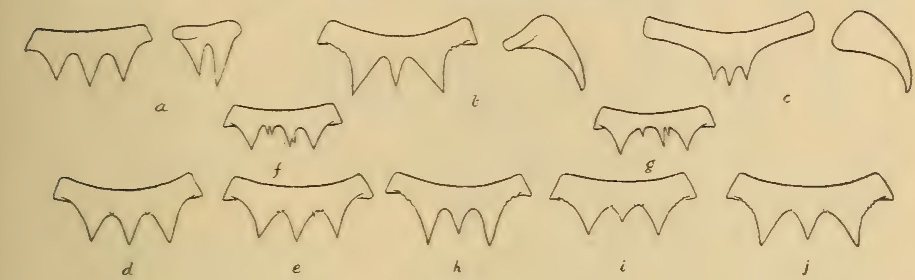


FIG. 15.

Central and lateral radula plates of (*a*) *Sylvanocochlis ancilla* (Hanley); (*b*) *Ancilla bullioides* Rve.; (*c*) *Melapium lineatum* (Lam.). Central plate of (*d*) *Ancilla fasciata* Rve.; (*e*) *A. fasciata-albozonata* Smith; (*f*), (*g*) *fasciata*, variation of cusps; (*h*) *A. obtusa* (Swainson); (*i*) *A. contusa* Rve.; (*j*) *A. errorum* Tomlin.

Kaffraria (Hanley), Port Elizabeth (Sowerby), Port Alfred (Bartsch, Turton); off Great Fish River, 40 fathoms, one dead (S. Afr. Mus. P.F. coll.). Living: 33° 45′ S. 26° 44′ E. (off the Kowie), 40 fathoms (Sowerby 1903, typ. err. 34° 45′ S. 25° 44′ E.); Algoa Bay, 39 metres, living (U.C.T.). Off Cape St. Francis, 45 fathoms (Tomlin, *fide* Burnup).

The shell of the living specimen recorded by Sowerby from off the Kowie is in S. Afr. Mus.; no report was published on the animal.

Gen. ANCILLA Lam.

1799. Lamarck. *Mem. Soc. H. N. Paris*, i, p. 70.
1903. Von Martens. *D. Tiefsee Exp.*, vii, pp. 37, 38.
1925. Thiele. ibid., xvii, p. 189 (S. Afr. *Ancilla* species, comments on von Martens 1903).

Shell ovate-fusiform, spire low or high, often covered with callus; body whorl with basal spiral groove, which may form a denticle on outer lip. Parietal callus often extending down the columella; canal short and broad. Operculum oval, nucleus apical (or subapical); sometimes reduced in size or even absent.

Radula with tricuspid central plate, unicuspid lateral plate.

Remarks. A. osculata Sow. is transferred to the genus *Bullia*.

Although the basal groove is faintly traceable even in very worn specimens of *Ancilla*, and would scarcely have been overlooked by Smith, one cannot help

wishing for a re-examination of *Bullia ancillaeformis* Smith (1906. *Ann. Natal Mus.*, i, p. 37, pl. 7, fig. 8); the shell is so very like *A. bullioides* in shape. But the locality (Natal) is against it being *bullioides.*

Ancilla obesa Sow.

Fig. 16(*f*)

1859. Sowerby. *Thes. Conch.*, iii, p. 65, pl. 213, figs. 44, 45.
1932. Turton. *Mar. Sh. Port Alfred*, p. 32.

Not *obesa* von Martens 1903 = *callifera* Thiele 1925 = *reevei* Smith.

Spire without any covering of callus, parietal callus thin, profile of sides straight or very slightly concave, apex pointed. Aperture about twice as long as spire. Postnatal whorls 4. Basal groove meeting columella slightly above middle. 18 × 9·5 mm. Turton: 21 mm. long.

Operculum and radula?

Fawn, a spiral band of alternating orange-brown and white spots on upper part of whorls, below this on body whorl an irregular series of spots, and another series below the basal groove; between these, two series orange-brown axial zigzags forming a reticulate pattern, lower part of base brown; reflected columella white.

Port Elizabeth, Kowie and Port Alfred (Sowerby, Bartsch, Turton, S. Afr. Mus.). Tongaat (north of Durban), East London, and Still Bay (S. Afr. Mus.).

The record of 6 specimens in S. Afr. Mus., registered as having come from Hout Bay on west coast of the Cape Peninsula, is not acceptable.

No living specimens seen.

Ancilla reevei Smith

Fig. 16(*e*)

1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 37 (*Ancillaria obesa*, non Sow.).
1904. Smith. *J. Malac.*, xi, p. 29, pl. 2, fig. 11.
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 190, pl. 33 (21), fig. 15, and text-fig. 7 (radula) (*callifera*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 31, and var. *bipartita*, p. 31, pl. 6, no. 233.

Spire covered with thick callus, especially above aperture, right profile convex, left profile convex above, indented below (in the suture), apex pointed. Aperture about twice as long as spire. Postnatal whorls 4 (Smith: ? 5). Basal groove meeting columella about in middle. 22 × 10–11 mm. Turton: 24 mm. long.

Operculum?

Fawn, spire mostly brown, a brown band between the sutural indent and lower margin of callus with white spots on its lower border, a series of brown spots above the basal groove, extending upwards as zigzag or undulate brown

axial lines, often joining to form a reticulate pattern; lower part of base with 2 brown bands and a white one between them; parietal callus and reflected portion of columella white.

Radula (Thiele), central plate with small middle cusp flanked on either side by a large cusp, and externally 4–5 denticles.

Port Alfred and the Kowie (Smith, Bartsch, Turton, S. Afr. Mus.). 34° 51′ S. 19° 37′ E., 80 metres (von Martens, Thiele).

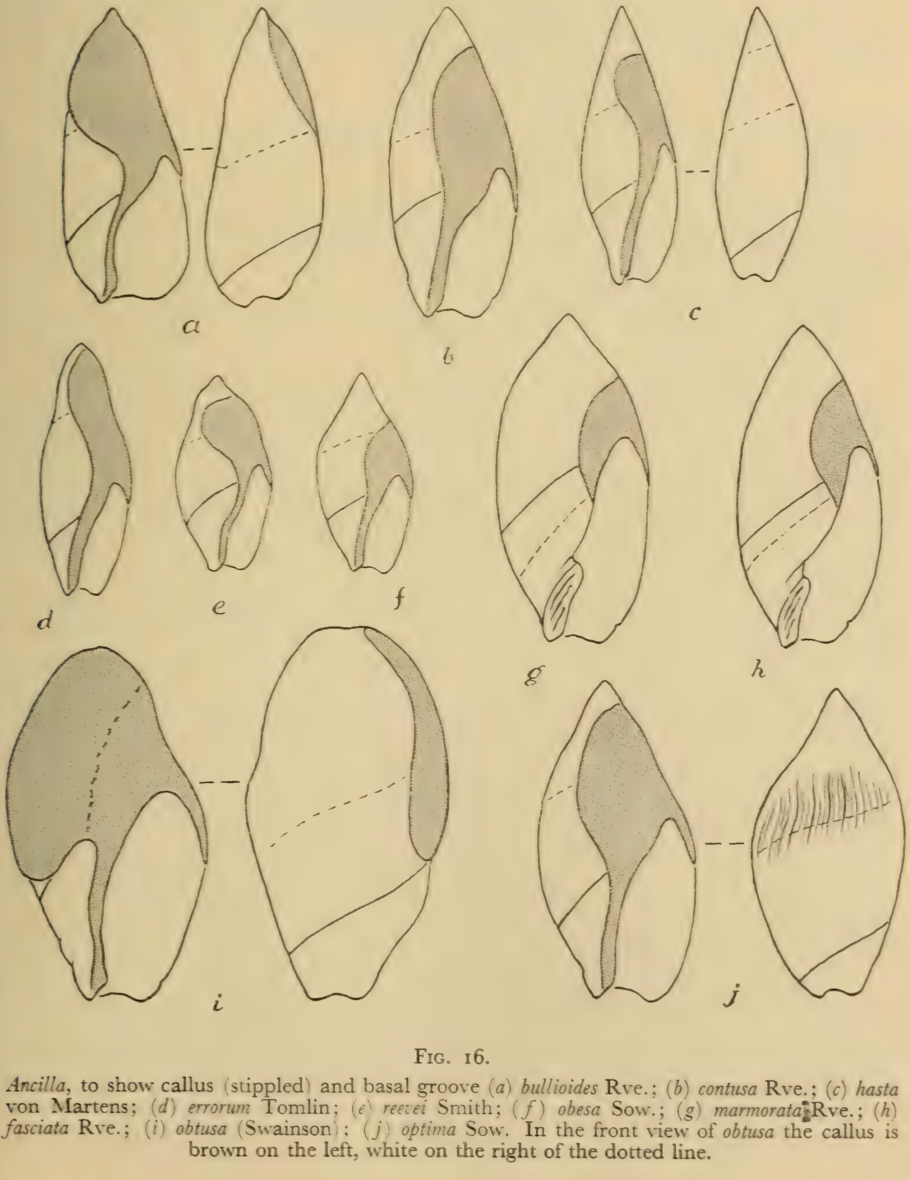


FIG. 16.

Ancilla, to show callus (stippled) and basal groove (*a*) *bullioides* Rve.; (*b*) *contusa* Rve.; (*c*) *hasta* von Martens; (*d*) *errorum* Tomlin; (*e*) *reevei* Smith; (*f*) *obesa* Sow.; (*g*) *marmorata* Rve.; (*h*) *fasciata* Rve.; (*i*) *obtusa* (Swainson); (*j*) *optima* Sow. In the front view of *obtusa* the callus is brown on the left, white on the right of the dotted line.

Remarks. Thiele was correct in not accepting von Martens's identification of the *Valdivia* shell as *obesa* Sow., but he overlooked Smith's species and proposed a new name.

The indent on the left side of the spire is characteristic, and together with the spire-callus distinguishes this species from *obesa*; the two species are very similarly coloured and pattern alone is not always decisive in separating them.

The spire-callus is not an adult character, but occurs on younger examples smaller than the largest ones of *obesa*; can it possibly be a sexual character?

Turton's *bipartita* lacks the indent on left profile of spire, but the specimen appears to be water-worn.

Ancilla obtusa (Swainson)

Figs. 15(*h*), 16(*i*)

1825. Swainson. *Q. J. Sci.*, xviii, p. 282 (*Ancillaria o.*).
1848. Adams & Reeve. *Voy. Samarang. Moll.*, p. 31, pl. 13, fig. 6.
1859. Sowerby. *Thes. Conch.*, iii, p. 62, pl. 211, figs. 15, 16.
1886. Watson. *Challenger Rep.*, xv, p. 229.
1913. Bullen Newton. *Rec. Albany Mus.*, ii, p. 348, pl. 24, figs. 3, 4 (*Baryspira* sp.).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 31.

Spire completely enveloped in callus. Shell ovate with shortly pointed apex, or obovate with bluntly rounded apex. Aperture about $1\frac{1}{2}$ times spire. Postnatal whorls ? (concealed in callus). Basal groove meeting columella at posterior third. Callus spreading laterally to left at top of aperture in a broad rounded lobe which is continued on to spire, and which is visible when shell is viewed from back (more so in adult than in juv.). 47 × 28 mm. Turton: 54 mm. long.

Operculum oval, slightly concave, nucleus subapical, 15 × 8 mm. in 39 mm. shell with aperture 29 mm.

Fawn or buff, a warm brown band on the base; the same colour shows through the callus on spire; callus on body whorl brown, parietal callus above aperture white; often arcuate or flame-like streaks on the brown body-whorl band; middle band margined above and below with white and usually showing the growth-lines. Operculum yellowish-horny or amber. Animal (Mossel Bay, U.C.T.) dirty white with rather coarse sepia-brown speckling.

Radula with 95–100 rows: middle cusp of central plate rather broad, smaller than the other two, outer margins of the latter crenulate.

Fossil, Mio-Pliocene: Redhouse, near Port Elizabeth (Newton); Quaternary: Sedgefield near Knysna (A. R. H. Martin).*

Port Elizabeth and Algoa Bay, Port Alfred (Sowerby, Bartsch, Turton, S. Afr. Mus.). Tongaat (north of Durban), Still Bay, Hermanus (S. Afr. Mus.). Simon's Bay, False Bay, 15–20 fathoms (presumably living) (Watson). Mossel Bay (living) (U.C.T.).

* For description of these deposits see: Martin. *S. Afr. J. Sci.*, 52, p. 187, 1956.

Off Cape Natal (Durban), 62 fathoms, off Glendower Beacon (Port Alfred area) and Great Fish Point, 66–100 fathoms, Mossel Bay and off Cape St. Blaize, 17–19 fathoms, all dead (S. Afr. Mus. P.F. coll.).

Algoa Bay, and off East London, 10–20 fathoms, living (S. Afr. Mus. P.F. coll.).

Remarks. Two young specimens 14 × 7 and 17 × 10 mm. are ovate in shape with pointed apex, with slightly convex profiles subtending an angle a little less than 90°. Larger specimens (21 mm. upwards) may retain the pointed apex (largest 42 mm.), or show various stages in its envelopment in callus, the final stage being a blunt and broadly rounded apex.

Four juveniles 2·5–4 mm., and one 6 mm. long (Still Bay, Muir coll.) may be this species, but no connecting links between the 6 and 14 mm. specimens are available. The smallest is 2·5 × 1·3 mm. $1\frac{1}{2}$ whorls. The 6 mm. specimen, though slightly worn, shows the characteristic shape of the callus. Juveniles 7 mm. and upwards of *fasciata-albozonata* (a species common at Still Bay) have a narrower apex, and the callus does not expand laterally in a rounded lobe.

Ancilla optima Sow.

Fig. 16(*j*)

1892. Sowerby. *Mar. Sh. S. Afr.*, p. 16 (*australis*, non Sow.).
1897. id., *Append. Mar. Sh. S. Afr.*, p. 7, pl. 6, fig. 31.

Shell ovate, spire not completely enveloped in callus, apex pointed, both profiles nearly straight. Aperture $1\frac{1}{2}$–$1\frac{2}{3}$ times spire. Postnatal whorls ? Body whorl gently shouldered, on upper portion with growth-lines forming low arcuate, obliquely protractive lirae. Basal groove meeting columella at about posterior quarter. Parietal callus expanding laterally, but not in a broad rounded lobe, and not visible when viewed from back, scarcely reaching apex. 53 × 27 mm.

Operculum oval, slightly concave, nucleus subapical, 17 × 9 mm. in 37 mm. shell with aperture 21 mm.

Fawn or buff; upper part of body whorl, spire, and base chestnut-brown, the upper brown band sharply defined from the pale middle band (which includes the basal groove) but becoming paler towards the (concealed) suture, the arcuate lirae paler than the ground colour.

Radula with about 75 rows (juv.); middle cusp of central plate narrow, shorter than the other two, outer margin of the latter denticulate, a minute denticle on either side at base of middle cusp (cf. fig. 15(*b*), *bullioides*).

Durban (Sowerby); Pondoland coast (S. Afr. Mus.); off Durban, 40 fathoms, from fish stomachs (S. Afr. Mus. Ross-Frames coll.).

Living: off Cape Vidal and O'Neil Peak (Zululand), off Cape Natal (Durban), and off Cape Morgan, 40–80 fathoms (S. Afr. Mus. P.F. coll.). Delagoa Bay (U.W.).

Remarks. The arcuate lirate growth-lines are distinctive.

The Delagoa Bay specimen is very dark, especially the base and the callus. The lirate growth-lines are covered by a film of callus and indistinct.

Three specimens from Tongaat (30 miles north of Durban) are also rather dark, the middle band darker than in typical *optima*.

Ancilla contusa Rve.

Figs. 15(*i*), 16(*b*)

1864. Reeve. *Conch. Icon.*, pl. 9, fig. 31.
1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 7, pl. 6, fig. 23 (*decipiens*).
1903. id. *Mar. Invest. S. Afr.*, ii, p. 228, pl. 3, fig. 3.
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 34 (*decipiens*).

Shell ovate, apex pointed, spire completely (or nearly so) enveloped in callus, profiles nearly straight or slightly convex, subtending an angle of *c.* 55°–60°. Aperture a little longer than (up to $1\frac{1}{4}$ times) spire. Postnatal whorls ? Basal groove meeting columella nearly at top of aperture. Callus expanding slightly at suture of body whorl (cf. *optima*) and continued on to spire. 52 × 25 mm.

Operculum oval, slightly concave, nucleus subapical, 11 × 5·5 mm. in 25 mm. shell with aperture 14 mm.

Cream or pale buff, spire usually white, but a faint brown sutural band sometimes shows through the callus; upper brown band usually well marked, especially its lower edge (where callus ends); a chestnut-brown band on base; on middle of body whorl a series of spiral brown bands or lines, varying in number and intensity, sometimes very indistinct.

Radula with *c.* 95 rows, middle cusp of central plate rather broad but smaller than the other two, outer margin of latter crenulate or denticulate, one or two minute denticles on either side of base of middle cusp.

Durban and Natal, 25–30 fathoms (Sowerby); Port Elizabeth (Sowerby: *decipiens*); Port Alfred (Bartsch: *decipiens*); Pondoland coast (S. Afr. Mus.). Natal, 25–27 fathoms, and from fish stomachs off Durban (S. Afr. Mus. P.F. coll.). Durnford Point (Zululand) 13 fathoms, living (S. Afr. Mus. P.F. coll.).

Remarks. A. decipiens is the beach-worn form of *contusa* tinged with pink or violaceous, as are several other South African beach-weathered shells.

Some specimens, especially when the spiral brown bands are indistinct or bleached out, may be difficult to separate from *optima*, but the arcuate lirae of the latter are usually distinctive.

Ancilla bullioides Rve.

Figs. 15(*b*), 16(*a*)

1864. Reeve. *Conch. Icon.*, sp. 37.
1886. Watson. *Challenger Rep.*, xv, p. 229 (*montrouzieri*, non Souv.).

1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 228 (*bulloides* [*sic*]).
? 1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 38 (*dimidiata*, non Sow. part: Sta. 113).
? 1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 35 (*bulloides* [*sic*]).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 191, pl. 33 (21), fig. 19 (cf. *montrouzieri*).
? 1932. Turton. *Mar. Sh. Pt. Alfred*, p. 32 (*bulloides* [*sic*]).

Bullia-like, the greatest width anterior to (below) middle of length. Ovate, spire high. Aperture a little longer than spire, expanded in lower half. Postnatal whorls ? Basal groove meeting columella nearly at top of aperture. Callus expanding laterally over the suture, extending to and covering the apex (the actual point of the apex is only thinly covered), partly visible in back view. 40 × 17 mm.; smallest example seen 14·5 mm. long.

Operculum slightly concave, oval, narrowing above, inner margin sinuous, nucleus subapical, 17 × 7 mm. in 40 mm. shell with aperture 20 mm.

Creamy-white, spire pale pinkish-orange or buff, a spiral band of the same colour on base. Operculum yellowish-horny or amber.

Radula with *c.* 75 (juv.) to 95 (adult) rows; middle cusp of central plate narrow, smaller than the other two, sometimes markedly so, outer margin of latter crenulate or feebly denticulate.

Off Cape of Good Hope, 98 fathoms (Watson); off Cape Peninsula, 190 fathoms (Sowerby). Living: south of False Bay, around Cape Point, off west coast of Cape Peninsula, and northwards to the Saldanha Bay area, 85–195 fathoms (S. Afr. Mus. P.F. coll.).

35° 11′ S. 23° 2′ E., 500 metres, dead shells inhabited by Hermit crabs (Thiele: Sta. 103, fig. 19).

The identification of specimens from Port Alfred (Bartsch, Turton) is very doubtful.

Remarks. Watson had one specimen and was unable to find any outstanding differences between it and the New Caledonian *montrouzieri*. Thiele also compared some specimens with the latter species. Nevertheless the two species are not likely to be synonymous. It is even more unlikely that this deep-water Cape species should be 'common' (Turton) on the beach at Port Alfred!

I have seen no authentic *dimidiata*. Von Martens recorded this species from three localities. I am inclined to think that his specimens from Sta. 113, south of False Bay, 318 metres, were really *bullioides*; those from shallow water 70 metres in Simon's Bay (False Bay) Sta. 114 were *errorum*; the third lot from Sta. 104 are from a locality farther east, not far from where *hasta* has been obtained.

Thiele suggested identifying all these with *bullioides*; but his fig. 18 is certainly not *bullioides*.

On the other hand, the specimens covered with *Epizoanthus* and inhabited by the Hermit crab *Parapagurus pilosimanus*, which Thiele compared with *montrouzieri*, are undoubtedly *bullioides*, although his fig. 19 has not quite the characteristic shape.

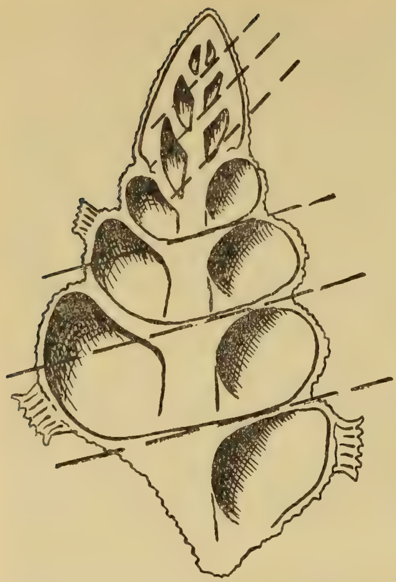


Fig. 17.

Section of *Ancilla* shell and the Coelenterate *Epizoanthus* inhabited by Hermit-crab (*Parapagurus pilosimanus*), showing alteration in angle of spiral when the crab has outgrown the Ancilla shell.

In the *Pieter Faure* collection there are numbers of such specimens. The Hermit crab has a wider distribution around the southern slope of the Agulhas Bank, and as far east as off East London (Barnard. *Ann. S. Afr. Mus.*, xxxviii, p. 451, 1950), but utilizes any dead shell. Its distribution is therefore no criterion for the distribution of the mollusc; in fact the only specimens of the crab inhabiting Ancilla shells come from the Cape Point area where living *bullioides* have been obtained. Thiele's record was 35° 11′ S. 23° 2′ E., 500 metres.

The *Epizoanthus* colony on a dead shell inhabited by *Parapagurus* continues to grow in a helicoid spiral, the pitch increasing *pari passu* with the girth of the crab. When a crab has occupied and outgrown an Ancilla shell the helicoid addition does not continue at the sharply acute angle of the Ancilla shell, but at a wider angle, so that in external view the crab appears to be occupying a Buccinoid shell (fig. 17).

Ancilla errorum Tomlin

Figs. 15(*j*), 16(*d*)

1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 229 (*angustata*, non Sow.).
? 1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 38 (*dimidiata*, non Sow., part: Sta. 114).
1906. Smith. *Ann. Natal Mus.*, i, p. 28 (*Marginella angustata*).
1921. Tomlin. *J. Conch.*, xvi, p. 216, pl. 8, fig. 2.

Shell ovate, greatest width at middle length. Spire moderately high, enveloped in callus. Aperture a little longer than spire. Postnatal whorls ? Basal groove meeting columella at upper quarter of aperture. Callus expanding laterally and continued almost to apex, not visible in back view. 15 × 7 mm.

Operculum oval, slightly concave, nucleus subapical, 6·5 × 2 mm. in shell 14 mm. with aperture 8 mm.

Pale buff or fawn, a brown sutural band, and another band on base. Operculum yellowish-amber.

Radula with *c.* 80 rows, middle cusp of central plate smaller than the side cusps, outer margin of latter denticulate, a minute denticle on either side at base of middle cusp.

Off Cape Point, 42 fathoms (Sowerby, Tomlin).

False Bay, Walker Bay, Algoa Bay, and off Umhloti River (Natal), 20–47 fathoms (S. Afr. Mus. P.F. coll.). 35° S. 20° 49′ E., 91 metres (s.s. *Africana*, per U.C.T.).

Remarks. Smith stated that Sowerby inadvertently recorded this species as an *Ancilla* instead of a *Marginella.* The statement, however, is incorrect and should be ignored, because the specimens recorded by Sowerby and returned by him are in fact *Ancilla.* The same specimens were later seen by Tomlin, who also saw the Natal specimen recorded above.

On account of the locality I am inclined to think the *Valdivia* specimens from Sta. 114, Simon's Bay (False Bay), 70 metres, identified by von Martens as *dimidiata*, should be referred here. Thiele without any mention of Tomlin's species, referred them to *bullioides.*

The species is a small edition of *bullioides* living in shallower water. A juvenile *bullioides*, 14·5 mm. long, however, is easily distinguished by the shape of its shell and of the callus.

Ancilla hasta von Martens

Fig. 16(*c*)

1902. Von Martens. *SB. Ges. naturf. Fr. Berlin*, p. 241.
1903. id. *D. Tiefsee Exp.*, vii, p. 37, pl. 3, fig. 13.
? 1903. id. ibid., p. 38 (*dimidiata*, non Sow., part: Sta. 104).
? 1925. Thiele. ibid., xvii, p. 191, pl. 33 (21), fig. 18 (*bulloides*, non Rve.).

Shell fusiform, greatest width at middle length, spire high, apex pointed. Aperture about $1\frac{1}{2}$ times spire. Postnatal whorls 7 (von Martens). Basal groove meeting columella at upper third of aperture. Callus expanding on body whorl suture, extending to but not covering the preceding suture, not visible in back view. 25 × 10 mm. Three other specimens 16–19 mm. long. 30 × 11 mm. (von Martens).

'Pale rosy-fulvous, white towards apex' (von Martens). Creamy-white, callus and sutures slightly darker buff.

35° 10′ S. 23° 2′ E., 500 metres (von Martens).

65–73 miles off Cape St. Blaize, 85–90, and 125 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. Von Martens does not mention the shape and extent of the callus. The *Pieter Faure* localities are near to that of the *Valdivia*, and the four dead specimens taken by the former vessel are undoubtedly referable to *hasta.*

The *Valdivia* specimens from Sta. 104. 35° 16′ S. 22° 26′ E., 155 metres, recorded by von Martens as *dimidiata*, may possibly be *hasta.* Thiele's figure 18 is much more like a *hasta* than a *bullioides.*

Ancilla fasciata Rve.

Figs. 15 (*d–g*), 16(*h*)

1864. Reeve. *Conch. Icon.*, sp. 44.
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 16 (*cinnamomea*, non Lam.).

1904. Smith. *J. Malac.*, xi, p. 29, pl. 2, fig. 9 (*albozonata*).
1925. Thiele. *D. Tiefsee Exp.*, xvii, pp. 190, 191, pl. 33 (21), fig. 17 (*agulhasensis*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 32, pl. 6, no. 238 (pattern var.) and p. 32 (*albozonata*).

Aperture about twice the spire. Basal groove meeting columella near upper end of aperture. Callus beginning about midway on columella, not much expanded laterally, continued upwards nearly to suture with preceding whorl. The lower of the two incised lines on base (the upper being the basal groove) nearer to the latter than to the reflected columella (contrast *marmorata*). 26 × 12 mm.

Operculum present but reduced in size, ovoid-oblong, slightly concave, growth-lines distinct, with very fine striae radiating from nucleus, 3 × 2 mm. in 17 mm. shell with 11 mm. aperture.

Brown, apex white, a white band below the brown suture on body whorl, another white band above reflected columella on base. The variety figured by Turton chequered with oblong brown spots.

Animal pale biscuit colour.

Radula with 80–90 rows, cusps on the central plate variable: all three may be subequal in size, with 1–4 denticles on either side of the middle cusp; sometimes there are (3) 4–5 cusps between the large side cusps, varying in size and arrangement, sometimes two of them united to form a bifid cusp. Thiele found the central plate had 5 smaller, somewhat irregular cusps between the two big ones.

Port Elizabeth and Port Alfred (auct. et S. Afr. Mus.).

St. Francis Bay, 80–100 metres, Algoa Bay. 35° 16′ S. 22° 26′ E., 155 metres, and (living) Simon's Bay (False Bay), 70 metres (von Martens, Thiele).

Off Tugela River (Natal), 37 fathoms, 1 alive; off Umhloti River (Natal), 100 fathoms, 1 dead; off Cape Natal (Durban), 85 fathoms, 1 alive; Algoa Bay to off Walker Point, 37–66 fathoms, living (S. Afr. Mus. P.F. coll.). False Bay, living (U.C.T.).

Remarks. As typical of this species and of *marmorata* I have had for comparison examples identified by Tomlin.

Thiele was unable to find any trace of an operculum in his specimens. His description of the radula bears out the variability of the cusps which I have found in several examples.

Ancilla marmorata Rve.

Fig. 16(*g*)

1864. Reeve. *Conch. Icon.*, sp. 32.
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 17, pl. 1, fig. 15 (*pura*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 38.
1906. Smith. *Ann. Natal Mus.*, i, p. 27, pl. 7, fig. 4 (*ordinaria*).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 190, pl. 33 (21), fig. 16 (referred with ? to *agulhasensis*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 32, and var. *major*.

Distinguished from *fasciata* by the two incised lines on base being farther apart, the lower one being midway between the upper line (which is the basal groove) and the reflected columella; clearly shown in Smith's and Thiele's figures. 19 × 9 mm. (S. Afr. Mus.), 21 × 9 mm. (Sowerby); 20 mm. long (Turton: var. *major*).

Operculum present but reduced in size, ovoid, with distinct growth-lines and very fine radiating striae, 2·5 × 1·5 mm. in 10 mm. shell with 6·5 mm. aperture.

Fawn or pale buff, sometimes with faint mottling or axial lines, a darker sutural band on body whorl, and another between the two incised lines; or pure white.

Radula with about 70 rows, cusps on central plate subequal in size, no denticle on either side of middle cusp (only one specimen examined).

Port Elizabeth (Sowerby: *pura*); Port Alfred (Turton, S. Afr. Mus.); Port Shepstone (Natal) (Smith: *ordinaria*).

35° 16′ S. 22° 26′ E., 155 metres (von Martens, Thiele).

Off Umhloti River (Natal) 40 fathoms, dead; off Cape Natal, 54 fathoms, living; off Umkomaas (Natal), 40 fathoms, living; off Cove Rock (East London area), 22 fathoms, dead but fresh; off Glendower Beacon (Port Alfred area), 66 fathoms, 1 alive; False Bay, 32 fathoms, 1 alive (S. Afr. Mus. P.F. coll.).

False Bay, 1 alive (U.C.T.).

Remarks. *A. pura* appears to be a somewhat slender example of this species, but Sowerby's figure is inadequate.

One living specimen was taken by the *Pieter Faure* off the west coast of the Cape Peninsula in 60 fathoms; it is white, and seems indistinguishable from *marmorata*. I should have assumed an error in labelling, unless confirmation had been provided by finding living examples in an intermediate locality, viz. False Bay (P.F., and U.C.T.). Its radula has 60 rows, the 3 main cusps on central plate subequal, on one side of the median cusp one small cusp, on the other side 2 small cusps.

The P.F. specimen from False Bay is fawn coloured, but the U.C.T. example is white.

Gen. Melapium H. & A. Adams

1853. H. & A. Adams. *Gen. Moll.*, i, p. 136.
1889. Smith. *Ann. Mag. Nat. Hist.* (6), iii, p. 267.
1929. Thiele. *Handbuch*, i, p. 332.
1937. Peile. *Proc. Mal. Soc.*, xxii, p. 182 (radula).

Shell broad, rounded-piriform, body whorl bulbous, outer lip expanded in adult. Spire low, protoconch papilliform. Columella curved, with a ridge from middle bordering the canal; strong parietal callus within aperture posteriorly. Periostracum thin. No operculum.

Radula with broad central plate, tricuspid, lateral plate unicuspid (as in *Oliva*).

Melapium elatum (S. & W.)

1829. Schubert & Wagner. *Conch. Cab.*, xii, pp. 92, 94, pl. 226, figs 4012, 4013 (*Pyrula e.*).
1901. Smith. *J. Conch.*, x, p. 110.
1952. Bayer. *Zool. Med.*, xxxi, no. 25, p. 297 (as syn. of *lineatum*).

Large. Whorls 4, last whorl with a blunt but definite shoulder. 63 × 61 mm. (protoconch worn).

White with numerous narrow axial brown or orange lines, slightly undulate and sometimes broken into discontinuous streaks.

Off Durban, 40 fathoms (from fish stomachs) (Smith, 1901).

Distribution. East Indian seas.

Remarks. Smith's record is the only one with precise locality. S. Afr. Mus. has 4 large specimens and one half-grown from the Ross-Frames collection, without locality; but they look as if they might have been taken from fish stomachs, from which source Ross-Frames is known to have obtained some of his shells.

Bayer includes this species as a synonym of *lineatum*. Probably only one species should be recognized. The smallest of the 5 specimens ex coll. Ross-Frames measures 40 × 38 mm. and has a definite shoulder on the last whorl.

Melapium lineatum (Lam.)

Fig. 15(*c*)

1822. Lamarck. *Anim. sans. Vert.*, vii, p. 147, no. 27 (*Pyrula l.*).
1856. Wood. *Index Test.*, ed. Hanley, p. 212, pl. 4, fig. 8 (*Buccinum bulbus*).
1889. Smith. *Ann. Mag. Nat. Hist.*, iii, p. 269 (with radula).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 26.
1903. Thiele. ibid., p. 166, pl. 9 (4), fig. 51 (radula).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 62 (*bulbosum* err.).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 191.
1932. Turton. *Mar. Sh. Port Alfred*, p. 79 (*bulbosum* err.).
1937. Peile. loc. cit., p. 182, fig. 16 (radula).
1951. Barnard. *Beginner's Guide S. Afr. Sh.*, p. 69, pl. 6, fig. 15 and fig. 37 (egg-capsules).
1952. Bayer. *Zool. Med.*, xxxi, p. 297 (references).

Protoconch, all specimens worn. Postnatal whorls 4. Last whorl without any trace of a shoulder; 3rd and beginning of 4th whorl with 4–5 feeble spiral striae on upper part. 30 × 28 mm.; smallest example seen 9 × 6 mm.

White with numerous axial brown or orange lines, sometimes undulate or arcuate or discontinuous, sometimes in addition an irregular series of oblong (axially) spots around the periphery; anterior canal externally suffused with crimson.

Animal (as preserved) foot dull buff with 2 submarginal red lines; Prof. Day says the margin is blue when alive.

Radula with 60–65 rows.

Natal (Krauss); Port Alfred, Port Elizabeth and Algoa Bay, St. Francis Bay (auct.); Port St. Johns and Still Bay (S. Afr. Mus.); O'Neill Peak (Zulu-

land), 90 fathoms; off Tongaat, 36 fathoms (S. Afr. Mus. P.F. coll.). Living: East London to Mossel Bay, 19–50 fathoms (S. Afr. Mus. P.F. coll.), also Mossel Bay (U.C.T.); 33° S. 28° 11′ E., 31 fathoms (U.C.T.).

Remarks. Some of the Still Bay beach specimens (Muir coll.) are quite fresh, with unfaded brown streaks and spots; quite possibly the species lives as far west as this locality.

Egg-capsules. Six specimens (P.F. coll. Nov.-Dec. 1898, off Cape Recife) each with 2 capsules attached on outer side of the parietal wall and curving inwards towards the aperture. 10–11 × 5–6 mm., subcylindrical, cross-section somewhat triquetral; the two inner surfaces horny, but the outer surface feebly calcified. One contained a single crushed embryo; all the others were longitudinally split and empty. This embryo could not be definitely determined as a *Melapium*, consequently these capsules can only be presumed to belong to this mollusc. It seems unlikely, however, that another species would deposit its egg-capsules in this position, and moreover they have not been found attached to any other Gastropod.

One of the U.C.T. East London specimens also carried two egg-capsules (empty): 21 May 1958.

Fam. *FASCIOLARIIDAE*

Gen. Fasciolaria Lam.

1911. Strebel. *JB. Hamb. Wiss. Anst.*, xxviii, pp. 1–58, 15 pls.

Shell usually large, fusiform, not umbilicate; canal rather long. Parietal callus present or absent; columella with 3 pleats, sometimes with additional wart-like nodules; columella glaze adnate throughout to the rostrum. Protoconch large.

Operculum ovate, apex incurved, nucleus apical; internal surface with thickened shiny margin, especially at apex.

Radula long, with 3 plates in each row, central plate quadrangular, tricuspid (sometimes a smaller one on either side externally), lateral plate wide, with numerous subequal cusps; the number of the latter increases with growth and is not always a specific character.

Egg-capsule stalked.

Remarks. As in many other genera plump and slender individuals of the same species occur. Strebel (pp. 1, 42) mentioned the possibility of this being a sexual difference, and deplored the lack of evidence. Although only 5 individuals of one species of this genus have been available to me for sexing, they gave no support to the suggestion. (cf. *Burnupena delalandii*, p. 166).

Key to the South African species

1. No parietal callus . . . . *filamentosa*
2. Parietal callus present.

a. Profile convex, without angular shoulder.
- i. Spiral sculpture fine and regular . . . . *rutila*
- ii. Spiral sculpture irregular, coarser and finer lirae more or less alternating . . . . *lugubris*

b. Profile angular, with shoulder knobs.
- i. Protoconch small, diam. 1·5 mm. Shell usually with dark spiral lines, usually in pairs, sometimes unicolorous . . . . *trapezium*
- ii. Protoconch large, diam. (2·5 mm. worn) 3·5–5 mm. Shell unicolorous . . . . *heynemanni*

Fasciolaria filamentosa Lam.

1880. Von Martens. *Mauritius & Seychellen*, p. 245.
1911. Strebel. loc. cit., p. 34, pl. 6, figs. 33, 34; pl. 7, figs. 35–37; pl. 15, fig. 63.
1929. Thiele. *Handbuch*, i, fig. 377 (radula).
1952. Satyamurti. *Bull. Madras Govt. Mus.*, n.s. I, 2, pt. 6, p. 185, pl. 17, figs. 9 *a–c*.
1952. Braga. *Anais Est. Zool. Invest. Ultramar.*, vii, 3, p. 73, pl. 2, fig. 2.

No parietal callus. Aperture longer than spire. Profile convex, sometimes with slight shoulder. Protoconch 1½ whorls, small (see Strebel, pl. 7, fig. 37), smooth. Postnatal whorls 7; 1st with 7 axial ribs, increasing to 11 on middle whorls, on later whorls forming only slight swellings on the shoulder; crossed by 4 spiral lirae on 1st whorl, increasing in number on middle and later whorls, more or less regular above shoulder, but alternately broad and narrow below, the larger ones becoming better marked on the base. Columella pleats distinct, glaze narrow; outer lip internally plicate. 172 × 71 mm. (Strebel).

Radula, lateral plate with 13 cusps (Thiele, fig. 377).

Natal (Sowerby), Mozambique (Braga).

Distribution. Red Sea, Zanzibar, Réunion, Mauritius, Seychelles, Madagascar and Indo-Pacific to Japan.

Remarks. A variable species (Strebel), but distinguished by the absence of the parietal callus.

Turton's record from Port Alfred (1932. *Mar. Sh. Pt. Alfred*, p. 49) is probably not *filamentosa*. Sowerby's Natal record was probably a dead shell.

Fasciolaria rutila Watson

Figs. 18(*a*), 19(*c*)

1882. Watson. *J. Linn. Soc. Lond.*, xvi, p. 335.
1886. id. *Challenger Rep.*, xv, p. 242, pl. 13, fig. 6.
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 227, pl. 3, fig. 2 (juv. shell and radula).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 30.
? 1923. Odhner. *Göteb. K. Vet. Handl.*, xxvi, p. 6 (= *Med. Göteb. Mus.*, xxiii).
? Tomlin. *Ann. Natal Mus.*, v, p. 290.

Thin-walled, profile of whorls convex, without any shoulder. Protoconch (uncorroded) large, subglobular, 1 or 1½ whorls, diam. 5·5–7 mm., alt. 5–6 mm. (corroded: diam. 3·5, alt. 3 mm.). Postnatal whorls 5, smooth in appearance, but with numerous fine spiral lirae closely set, *c.* 11–12 on 1st whorl, becoming

a little stronger and more widely spaced on later whorls. Parietal callus present; columella with 3 pleats, but posterior one feeble and obscure in large specimens. Canal long, narrow, sigmoid; outer lip thin, not plicate internally. Periostracum thin. 132 × 51 mm.

Operculum 35 × 19 mm. in 132 mm. shell.

White with pale yellowish brown periostracum, operculum dark brown.

Radula with 230–250 rows, usually an accessory denticle externally on both sides on the central plate; lateral plate with 8 cusps in juv. (figured by Sowerby), in adult 13 on one side and 14 on the other (2 specimens), or 15 and 16 resp. (one specimen) (excluding the tiny internal denticle).

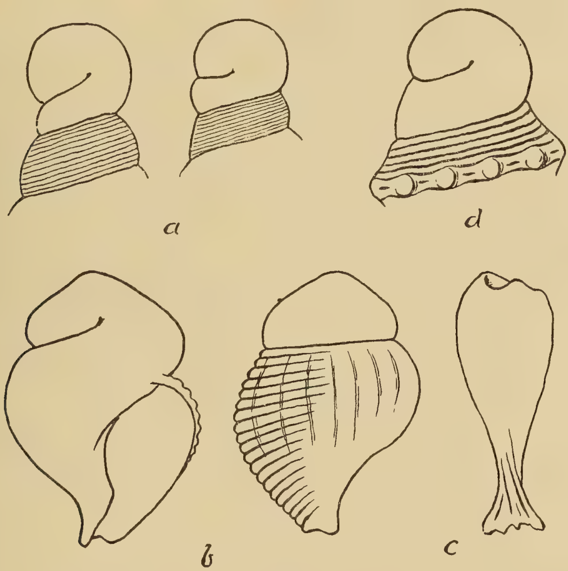


FIG. 18.

(*a*) *Fasciolaria rutila* Watson, protoconchs of two shells.
(*b*) *F. lugubris* Rve., two views of protoconch extracted from
(*c*) egg-capsule. (*d*) *F. heynemanni* Dnkr., protoconch.

Living: 35° 4′ S. 18° 37′ E., 150 fathoms (Watson); 33° 41′ S. 18° E., 178 metres (von Martens); off Cape Peninsula, 154 fathoms (Sowerby: juv.); off Cape Point, 85–145 fathoms (S. Afr. Mus. P.F. coll.); 33° 11′ S. 17° 57′ E., 77 metres; 31° 39′ S. 16° 55′ E., 287 metres (s.s. *Africana*); ? off Umhloti River (Natal), 40 fathoms (Sowerby).

Dead? St. Sebastian Bay, 40 fathoms (Odhner); off Cape St. Francis (Tomlin, coll. Burnup).

Remarks. The Burnup shell recorded by Tomlin was 5¼ in. (133 mm.) long.

The *Pieter Faure* obtained only one shell off the Natal coast (if the label was correct); all the others were from off the Cape Point. The *Africana* has shown that the distribution extends to 31° S. on the west coast. The large Natal

specimen, now in the British Museum, should be re-examined on account of its alleged locality.

More probable misidentifications are Odhner's 150 mm. and Burnup's 133 mm. shells. I consider that both of these are more likely to be the off-shore form of *lugubris*, which has stronger and more irregular spiral liration than *rutila*; the latter also has a more sigmoid canal.

Fasciolaria lugubris Rve.

Figs. 18(*b*, *c*), 19(*a*, *b*)

1847. Reeve. *Conch. Icon.*, sp. 2.
1848. Krauss. *Südafr. Moll.*, p. 110, pl. 6, fig. 12 (*badia*).
1911. Strebel. loc. cit., p. 31, pl. 6, figs. 30, 30*a*, 31.
1932. Tomlin. *Ann. S. Afr. Mus.*, xxx, p. 157, fig. 1 (*agulhasensis*).
1932. Haughton. *Tr. Geol. Soc. S. Afr.* (1931), pp. 34, 49.

Aperture longer than spire. Profile of whorls evenly convex, but sometimes with faint indication of a blunt shoulder, rarely a definite shoulder with low knobs. Protoconch (from egg-capsule) $1\frac{1}{2}$ whorls, diam. 3–3·5, alt. (i.e. apex to rostrum) 5 mm., smooth, later part of whorl with 6–8 feeble axial ribs, crossed by spiral lirae, *c.* 20 from suture to lower end of outer lip. Postnatal whorls 7; 10 axial ribs on 1st whorl, on 2nd and 3rd and sometimes 4th a similar number of slight undulations or low rounded knobs, obsolete on later whorls; crossed by numerous spiral lirae, varying in size, usually coarser and finer alternating, the larger ones sometimes with one or more striae, the peripheral lira sometimes distinctly stronger than its neighbours, almost a costa (*agulhasensis*), sometimes a pair of peripheral lirae stronger than the others. Parietal callus present, but weak in young and half-grown shells; columella pleats distinct. Outer lip evenly convex, not so distinctly incurved at beginning of canal as in *heynemanni*, plicate internally, edge at some stages of growth denticulate. Periostracum fibrous-fimbriate. 183 (tip of canal broken, about 5 mm. missing) $\times$ 75 mm. (type of *agulhasensis*); two False Bay examples (tip of canal broken in both) 145 $\times$ 52 mm. and 142 $\times$ 55 mm. Largest littoral example 81 (tip of canal broken) $\times$ 43 mm.

Operculum 28 $\times$ 14 mm. in 81 mm. shell.

Protoconch and first 2 ($2\frac{1}{2}$) whorls white, rest fulvous or chestnut-brown, operculum dark brown. Animal sealing-wax red with white dots on sides of foot (K.H.B.).

Radula: from protoconch in egg-capsule, 40 rows, lateral plate with 6 cusps; from 18 mm. shell 135 rows, lateral with 8 cusps; from 33 mm. shell 190 rows and 11–12 cusps resp.; from 85 mm. shell 225 rows and 12 cusps resp.; from 142 mm. shell 265 rows and 14–16 cusps resp. (in all cases excluding the tiny internal denticle); central plate quadrangular, with well-developed cusps, the middle one stronger than the side cusps.

Egg-capsule club-shaped, 20 mm. high, distally elliptical in section, major diam. 9 mm., minor diam. 8 mm., horny; only one specimen seen, containing

4 embryos, but the apex was open and some of the embryos had probably escaped.

Fossil, late Tertiary; Saldanha Bay (Haughton).

Dead. Natal (Krauss); False Bay (Strebel, coll. Fritsch); Cape Hangklip (S. Afr. Mus.); between Cape St. Blaize and Flesh Point, 28 fathoms (S. Afr. Mus. P.F. coll. type of *agulhasensis*).

Living. Steenberg Cove (St. Helena Bay) and Langebaan (Saldanha Bay), littoral (U.C.T.); Oudekraal, west coast of Cape Peninsula, littoral (U.C.T.); Sea Point, Cape Town, littoral (S. Afr. Mus.); Kalk Bay (False Bay), littoral (S. Afr. Mus.), and 4–5 metres (U.C.T.).

Remarks. The striae on the larger spiral lirae are not (in the specimens I have seen) so prominent as Strebel described in his specimens, and cannot be regarded as a specific character.

I have seen a 51 mm. shell from Cape Hangklip (S. Afr. Mus. no. 14052), and a 95 mm. shell from False Bay (U.C.T.) with distinct angular shoulders and two peripheral lirae. Another False Bay example 142 mm. long (U.C.T.) has 9 peripheral swellings on the 6th whorl, but none on the preceding whorls. The resemblance of these specimens to *heynemanni* is strong, but the latter species has finer and more regular lirae above the shoulder, and the shoulder projections are definitely knobs, not mere swellings or undulations; and the 2 peripheral lirae are situated in the middle of the whorl, not as in the *dunkeri* form of *heynemanni* adjoining the suture of the following whorl.

The contrast between the smooth slender examples and, e.g. the 95 × 46 mm. shouldered specimen is very striking, and is paralleled with the *adamsii* and *ocelliferus* forms of *Fusus verruculatus* (p. 90).

Littoral examples are smaller and stouter than off-shore forms (cf. *heynemanni*).

The 145 × 52 mm. shell from False Bay, 23 fathoms, was identified by Tomlin as *filamentosa* in spite of its having a parietal callus. It bridges the gap in size between the common littoral form and *agulhasensis*. The latter was contrasted by Tomlin with *scholvieni*, an obviously different species, but he did not mention any differences between his n. sp. and *lugubris*. In fact there are no differences.

Krauss said his *badia* was very like *Fusus mandarinus*, and also bore resemblance to *Fasciolaria fusiformis* and *filamentosa*.* There are no later records of *lugubris* from Natal, or indeed from east of Cape St. Blaize.

Fasciolaria trapezium Linn.

1880. Von Martens. *Mauritius & Seychellen*, p. 245.
1895. Cooke. *Cambr. Nat. Hist.*, iii, fig. 121 (radula).
1903. Smith. *Proc. Mal. Soc.*, v, p. 368 (*heynemanni*, non Dnkr.).

* See also *Fusivoluta pyrrhostoma* (Volutidae) for the *Gazelle* shells reported to be *Fusus mandarinus* (p. 30).

1911. Strebel. loc. cit., pp. 40 sqq. and vars. pls. 7–10, 13, 14, figs. 38–45, 48, 49, 61, 62.
1930. Fulton. *Ann. Mag. Nat. Hist.* (10), vi, p. 685, pl. 18, figs, 2, 2*a* (*strebeli*).
1952. Satyamurti. *Bull. Madras Govt. Mus.*, I, 2, pt. 6, p. 186, pl. 17, fig. 10.
1952. Braga. *Anais Est. Zool. Invest. Ultramar*, vii, 3, p. 73, pl. 2, fig. 1.

Aperture longer than spire. Profile of whorls with angular shoulder. Protoconch 1½ whorls, diam. 1·5 mm., smooth (Strebel, figs. 38, 42). Postnatal whorls 9 (? 10); spiral grooves only on early whorls but indicated on later whorls by dark lines; on 1st and 2nd (–3rd) whorls 8–9 axial ribs extending from suture to suture, but on later whorls gradually restricted to the periphery and forming knobs on the shoulder, which becomes definitely marked from 4th whorl onwards: 5–7 in forma *typica*, 8–11 in varieties. Parietal callus present, but weak in juveniles. Columella with 3 pleats, and often additional wart-like nodules anterior to the main pleat; canal straight or slightly sigmoid; outer lip internally with numerous plicae, usually a smooth zone between the plicae and the edge; the latter in some stages of growth denticulate. Up to 215 mm. long (f. *typica*); var. *ponderosa* 230 mm. (Strebel).

White or pinkish, with narrow brown spiral lines usually in pairs, plicae in aperture orange-brown, periostracum yellowish-brown.

Radula (only a portion removed from a 153 mm. shell); lateral plate with 30 cusps. Cooke's figure shows 22 cusps.

Dead. Durban (Sowerby, Smith); Natal (Fulton, and S. Afr. Mus.); Inhambane and Mozambique Island (Braga).

Living. 28° 28′ S. 32° 25′ E. (off Cape St. Lucia), 27 metres (s.s. *Africana*).

Distribution. Red Sea, Zanzibar, Querimba Is., Mauritius, Réunion, Seychelles, Madagascar, Indo-Pacific.

Remarks. The relatively small protoconch distinguishes this species from *heynemanni*, apart from other characters. Smith's mention of the small protoconch indicates that his two specimens were really young *trapezium*.

A Natal specimen, 53 × 24 mm. (S. Afr. Mus.) might certainly be regarded as *heynemanni* because it is unicolorous without any trace of the dark spiral lines so characteristic of *trapezium*; but it has the small protoconch (and narrower 1st and 2nd whorls) of *trapezium*.

The living specimen, 153 mm. long, dredged by the s.s. *Africana* has indications of double lines only on the latest part of the outer lip, and only feeble colourless plicae within; the base is quite smooth, without costae or lirae; the protoconch is broken off, but was probably small.

That the characteristic dark spiral lines are not always developed in juveniles and half-grown *trapezium* is shown by Smith's (size not given), Fulton's 69 mm., and the S. Afr. Mus. 53 mm. examples. In addition to the one Natal specimen, S. Afr. Mus. also has examples from extra-African localities. Even the 153 mm. *Africana* specimen was only just beginning to develop these dark lines.

Fulton's reasons for separating his *strebeli* from *heynemanni* were its more slender shape and absence of well-marked spiral lirae; Smith also mentioned

these characters. But neither Smith nor Fulton mentioned the *size* of the protoconch, which, according to Fulton's photographic figure, was small; nor did they compare their specimens with *trapezium.*

A further difference between *trapezium* and *heynemanni* is: the former develops six whorls against the latter's four, in half-grown specimens of approximately equal size.

Fasciolaria heynemanni Dnkr.
Fig. 18(*d*), 19(*d*)

1876. Kobelt in *Küster. Conch. Cab.*, p. 139, pl. 28, fig. 5.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 30.
1911. Strebel. loc. cit., p. 28, pl. 5, figs. 27, 28; and p. 31, pl. 6, fig. 29 (*scholvieni*); and p. 33. pl. 6, figs. 32, 32 *a*, *b* (*dunkeri*).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 46, pl. 4, figs. 3, 3*a*, 3*b* (*alfredensis*).
1923. Odhner. *Göteb. K. Vet. Handl.*, xxvi, p. 6 (*alfredensis*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 49; and p. 49, pl. xi, no. 362 (juv. *dunkeri*, non Strebel); and p. 49 (*scholvieri*, typ. err.); and p. 49 (*alfredensis*).
Not: Smith. *Proc. Mal. Soc.*, v, 368 (= *trapezium*).

Spire $1\frac{1}{2}$–2 times in aperture. Profile of whorls with angular shoulder. Protoconch $1\frac{1}{2}$ whorls, large, diam. 3·5–4·5, alt. 3–4 mm., smooth, last half whorl with about 6 axial ribs, from suture to suture, continued on 1st postnatal whorl, but restricted to the periphery and forming knobs, 5–6 spiral lirae above the knobs, increasing to 8 or more on later whorls. Postnatal whorls 6, with peripheral knobs varying in size, and in number from 9–14. Spiral lirae over whole whorl, including the knobs; on base 8–10 more or less conspicuous very flat costae, each traversed by about 3–5 lirae; usually only one, but sometimes 2 (*scholvieni*) of these costae appear between the knobs and the suture of the following whorl. On the rostrum the spiral lirae become almost axial in direction (parallel with the canal), distinct in examples with straight rostrum but obscured by the growth-lines in those with costate rostrum. Parietal callus present. Columella with 3 pleats. Canal long, narrow, straight or slightly sigmoid, especially when left side of rostrum is thickened and costate. Outer lip slightly flattened in the middle and incurved below, not plicate internally, in some examples with denticulate edge. 203 (protoconch and tip of canal broken) $\times$ 80 mm.; slenderest specimen 160 $\times$ 55 mm.

Operculum 62 $\times$ 33 in 203 mm. shell.

Pale buff or white, unicolorous, periostracum usually chestnut-brown, but sometimes olivaceous golden-brown (Cape St. Blaize example) or golden-brown (False Bay example); protoconch white; operculum dark brown.

Radula with *c.* 230–280 rows, lateral plate with 15 cusps on one side, 16 on the other, in another specimen 17 and 18 (excluding the tiny internal denticle); middle cusp of the central plate asymmetrically bifid in one specimen.

Dead. Natal (Kobelt); Port Elizabeth, Port Alfred (Sowerby, Strebel, Bartsch, Turton, S. Afr. Mus.); Elim (i.e. Bredasdorp coast, Cape Agulhas area) (Strebel: *dunkeri*); 'Cape' (Strebel: *scholvieni*); off Glendower Beacon

(Port Alfred area), 66 fathoms (S. Afr. Mus. P.F. coll.). Delagoa Bay S. Afr. Mus. coll. K.H.B. 1912).

Living. Between Plettenberg Bay and St. Francis Bay, 100 metres (von Martens); off Cape Infanta, 34–40 fathoms (Odhner) (also dead examples); off Kowie, 40–43 fathoms; Algoa Bay, 40 fathoms; off Cape St. Blaize, 46 fathoms; False Bay (S. Afr. Mus. P.F. coll.). Cape Agulhas, littoral (U.C.T.).

Remarks. A variable species, as was recognized by Strebel. He figured the 'deep-water' and the 'coastal' forms. The former has a straight non-costate rostrum, the latter a costate rostrum. But the present series shows that this difference is not due to habitat, because both were obtained together in one haul off the Kowie (P.F.); nor does it seem to be sexual because out of 5 animals 2 ♂♂ and 1 ♀ are non-costate, 2 ♀♀ costate.

This costate thickening of the rostrum seems to appear only in specimens approximately 100 mm. in length upwards.

At the Kowie locality plump and slender examples were taken in the same haul: width approx. 2·2–2·8 in the length, spire varying from $1\frac{1}{2}$, $1\frac{3}{4}$, to 2 times in aperture (incl. canal), knobs 9 (in smallest specimen 58 mm. long) to 14 (the 2 largest examples 203 and 187 mm. had 11 and 13 knobs resp.).

The peripheral knobs are usually in the middle of the whorl, but may be lower (more anterior); in *dunkeri* they adjoin the suture, except on the last preserved whorl.

In some juveniles 2 subequal series of knobs are developed (cf. *dunkeri*).

It is difficult to decide where the protoconch ends and the 1st postnatal whorl begins. The apex of the subglobular protoconch ($1\frac{1}{2}$ whorls) is white, the 1st postnatal whorl brown, but there is no sharp division between the two. The axial ribs begin on the last part of the white region and are continued, without any obvious interruption of growth, on the brown 1st whorl. One specimen of protoconch is very large: diam. and alt. both 4·5 mm.

The curve of the outer lip helps to distinguish this species from *lugubris*, but not from *trapezium*.

Strebel suggested that *scholvieni* might possibly be a large form of the dwarf *heynemanni*; but the present material negatives this; the differences are merely individual.

Bartsch's *alfredensis* was based on a worn slender specimen. Although the plump, short-spired forms with strong knobs look different from the slender, high-spired forms with weaker knobs, the present S. Afr. Mus. material, meagre as it is, exhibits transitional forms.

F. dunkeri, based on one young specimen (41·5 × 19·3 mm.), I regard as an aberration. In some young examples of typical *heynemanni* the knobs on the early whorls are very close to the suture of the following whorl; and in some very young specimens a double row of feeble knobs occurs; but I have seen no specimen exactly corresponding with *dunkeri*, i.e. with a *double* peripheral shoulder *adjoining the suture.*

In spite of Kobelt's record from Natal, the Delagoa Bay locality is remarkable. I cannot doubt the provenance because I myself found the specimen. One would expect to find *trapezium* there, but the specimen is a typical *heynemanni* without a single one of the features distinguishing the Indo-Pacific species. It retains the periostracum, and is thus unlikely to have been carried very far by currents; moreover the Mozambique current sets in the wrong direction to have carried this shell from Natal or the Port Alfred area.

Gen. Latirus Mont.

1810. Montford. *Conch. Syst.*, ii, p. 530.
1840. Swainson. *Treat. Malac.*, lxxviii, p. 304 (*Plicatella*).
1891. Melvill. *Mem. Manch. Philos. Soc.*, n. ser. 4, vol. 4, pp. 365–411 (*Latirus* + *Peristernia*).
1911. id. *J. Conch.*, xiii, p. 164 (*Latirus* + *Peristernia*).

Shell ovate or fusiform, usually ribbed. Canal long or short, columella usually with pleats, aperture sometimes internally plicate. Operculum ovate, apex curved inwards, nucleus apical, internal surface as in *Fasciolaria* (? all species).

Radula central plate tricuspid, lateral plate with several cusps without intervening smaller denticles.

The South African species fall into two groups:

Whorls with peripheral knobs—
abnormis, *subcontractus*.

Whorls with axial ribs and spiral lirae—
polygonus, *clausicaudatus*, *bairstowi*, *rousi*, *alboapicatus*, *turritus*.

No living examples of *bairstowi* Sow. 1886 or *rousi* Sow. 1886 have yet been found. The only South African record of *turritus* (Gmelin) is a dead shell from Durban (Sowerby 1897); the species occurs at Mauritius, Seychelles, Ceylon, etc.

Latirus abnormis Sow.

1894. Sowerby. *J. Conch.*, vii, p. 6.
1897. id. *Append. Mar. Sh. S. Afr.*, p. 8, pl. 6, fig. 7.
1902. id. *Mar. Invest. S. Afr.*, ii, p. 96, pl. 2, fig. 1 (*imbricatus*).
1903. id. ibid., p. 227.
1911. Melvill. *J. Conch.*, xiii, p. 165.

Aperture (incl. canal) a little longer than spire. Protoconch 2 whorls, diam. 1·7, alt. 1·3–1·5 mm., smooth, junction with 1st postnatal whorl distinct. Postnatal whorls 7, profile concave above the periphery, in some specimens rather strongly so, almost forming a subsutural groove. Axial ribs 10 on 1st whorl, well marked on periphery but feeble above and below, decreasing to 7–8 peripheral knobs on later whorls; crossed by 4–5 spiral lirae on 1st whorl, increasing by interpolation on later whorls, but evanescent on 6th and 7th whorls; 2 of the peripheral lirae on whorls 2–5 stronger than the others, making the knobs subcarinate, but obsolete on knobs on 6th and 7th whorls; spiral

lirae continued on base, 2 of them in upper third (at posterior end of aperture) stronger than the others and forming a series of feeble subcarinate knobs corresponding in position with the peripheral knobs. Parietal callus weak; columella without pleats. Canal not abruptly separated from rest of aperture, which is posteriorly more or less indented; columella glaze in large specimens discrete from rostrum forming a narrow umbilicus; outer lip not plicate within. Periostracum thin, fibrous, imbricate-scaly. 72 × 29 mm. (S. Afr. Mus.); Brit. Mus. specimen (when perfect) probably 75 mm. long (Smith).

Operculum ovate, gently curved, 13 × 6·5 mm. in 49 mm. shell, internal surface as in *Fasciolaria*.

Ochraceous salmon, or orange-brown, periostracum amber-brown, operculum brown.

Living. Off Durnford Point (Zululand), 13 fathoms (S. Afr. Mus. P.F. coll.).

Dead. Natal (probably from fish stomachs) (Smith); off Tugela River, 46 fathoms (Sowerby), and 14 fathoms (S. Afr. Mus. P.F. coll.).

Latirus subcontractus (Sow.)

1902. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 97, pl. 2, fig. 2 (*Fusus s.*).
1932. Tomlin. *Ann. S. Afr. Mus.*, xxx, p. 158, fig. 2 (*mosselensis*).

Aperture a trifle longer than spire. Protoconch 2 whorls, diam. 1·3, alt. 1 mm. smooth, beginning of 1st postnatal whorl distinct (type of *mosselensis*). Postnatal whorls 8; 9 (? 10) (*subcontractus*) or 8 (*mosselensis*) axial ribs on each whorl, from suture to suture on 1st–3rd whorls, but from 4th whorl restricted to the periphery; crossed on 1st whorl by 5 spiral lirae, increasing on following whorls, but from about the 5th whorl evanescent, except the peripheral lira which persists on the knobs (not in the intervals) making these subcarinate; on base a second series of weaker subcarinate knobs, and a few weak lirae on rostrum. Parietal callus weak, columella with 2 obscure pleats (*mosselensis*); canal rather abruptly demarcated from rest of aperture, narrow (*subcontractus*). A narrow umbilicus (*mosselensis*); outer lip not plicate internally. Periostracum thin, smooth. 40 × 18 mm. (*subcontractus*); 53·5 × 23 mm. and 60 × 25 mm. (type and figure of paratype of *mosselensis*).

Operculum ovate, gently curved (Tomlin).

Pale pinkish, periostracum yellowish-brown (*mosselensis* type).

Dead: off Cape Natal (Durban), 200 fathoms (Sowerby).

Living: Mossel Bay, 27 fathoms (Tomlin) (both S. Afr. Mus. P.F. coll.).

Remarks. Has a strong resemblance to a *Fasciolaria*, cf. *heynemanni* or *trapezium*.

Type of *subcontractus* ? in British Museum. Tomlin figured the paratype (? in coll. Tomlin) with operculum, and the back view of the type of *mosselensis*. The latter is in S. Afr. Mus. without operculum. The radula was not described.

Tomlin compared his species with *L. armatus* A. Adams 1854 (see 1886. *Challenger Rep.*, xv, pl. 13, fig. 1, *Fasciolaria armata*), but made no reference to the truly remarkable resemblance to Sowerby's species.

Except that *subcontractus* appears (from Sowerby's figure) to have one (? 2) more axial ribs (knobs) than *mosselensis*, and that the latter is rimate and has a slightly curved columella, there are no differences between Sowerby's figure and the type of *mosselensis*. The lower part of the canal and outer lip are broken in the latter, which may account for the umbilicus being visible.

In spite of the distance apart of the two localities, and the difference in depth, one cannot accept more than the one species.

Latirus polygonus (Linn.)

1816. Lamarck. *Tabl. Encyclo.*, pl. 423, fig. 1 (*Fusus p.*).
1859. Chenu. *Man. Conchyl.*, i, fig. 908.
1903. Smith. *Proc. Mal. Soc.*, v, p. 369 (var.).

The only South African record is from 'Durban, deep water' [probably from fish stomach] (Smith). The species occurs at Mauritius, and other localities in the Indian Ocean. Specimens in S. Afr. Mus. from Ceylon (coll. Rawson W. Rawson).

The coloration appears to be distinctive: buff or ochraceous, with brown axial ribs divided into oblong patches by the pale spiral lirae.

Latirus clausicaudatus (Hinds)

1844. Hinds. *Zool. Voy. Sulphur. Moll.*, p. 13, pl. 1, figs. 10, 11 (*Fusus c.*).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 3 (*Fusus c.*).

Elongate-fusiform, turreted, aperture (incl. canal) $1\frac{1}{4}$—$1\frac{1}{3}$ times spire. Profile of whorls evenly convex. Protoconch $2\frac{1}{2}$ whorls, diam. and alt. 2 mm., smooth, junction with 1st postnatal whorl distinct. Postnatal whorls 7; 7 axial ribs on 1st whorl, increasing to 8 or 9 on last whorl, from suture to suture but becoming weaker above periphery on later whorls, and evanescent on lower two-thirds of base; sometimes indistinct on last part of 7th whorl, but reappearing as a well-marked rib on outer lip; crossed by spiral lirae, 7–8 on 1st whorl increasing to 16–20 on later whorls, 35–40 additional on base. Parietal callus bluntly dentiform; columella with 2 pleats, the anterior one distinct, the other obscure; canal abruptly marked off from rest of aperture, very long, nearly twice the rest of aperture, nearly closed throughout its length by the discrete edge of the columella glaze, no umbilicus. Aperture internally without plicae except one at base of canal opposite the columella pleat. Periostracum thin, smooth. 51 × 15·5 mm., smallest specimen in S. Afr. Mus. 31 mm. long. Hinds's figure 58 × 16·5 mm.

Operculum oval, apex incurved, 7 × 3·5 mm. in 45 mm. shell.

White or pale buff, periostracum pale greyish brown, operculum dark brown.

Dead: Agulhas Bank, 50–60 fathoms (Hinds). Off Cape Natal (Durban), 54 fathoms; off Cape Morgan, 77 fathoms; off Nahoon Point (East London), 45 fathoms; off Hood Point (East London area), 49 fathoms; off Nanquas Peak (eastern part of Algoa Bay), 63 fathoms; Algoa Bay, 37 fathoms; (S. Afr. Mus. P.F. coll.).

Living: off Riet Point (east of Algoa Bay), 23 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. These specimens are clearly referable to Hinds's species, which Sowerby (1892, also 1903. *Mar. Invest. S. Afr.*, ii, p. 97) said was represented by the unique type in the British Museum.

In one specimen the protoconch and 3 whorls are slightly curved to the right, and in another the protoconch is curved to the left as in Hinds's figure.

The animal of the only specimen taken alive was not preserved.

Latirus alboapicatus Smith

1902. Smith. *J. Conch.*, x, p. 250, pl. 4, fig. 5.
1906. Smith. *Ann. Natal Mus.*, i, p. 34, pl. 7, fig. 7 (*burnupi*).
1911. Melvill. *J. Conch.*, xiii, p. 166 and p. 168 (*burnupi*).
1931. Tomlin. *Ann. Natal Mus.*, vi, p. 433.

Fusiform. Profile of whorls slightly angularly convex (fig. of *alboapicatus*), slightly concave above, then gently convex (*burnupi*). Protoconch 2 whorls, diam. and alt. *c.* 1·5 mm., smooth. Postnatal whorls 6; axial ribs *c.* 12 (*alboapicatus*) on 1st whorl (in *burnupi* corroded), 8 on 2nd and following whorls, from suture to suture, but more prominent on the periphery, and evanescent on base; crossed by spiral lirae (number not stated in *alboapicatus*) 5 on 2nd whorl increasing to 8–10 on last whorl, the first one or first 2 or 3 below suture granulose, 9–11 additional on base, of which the 4th or 5th is stronger than the others, covered posteriorly by the parietal callus and forming a small denticle on outer lip; columella with 3 weak pleats, canal straight (slightly recurved in *alboapicatus*), distinctly but not abruptly marked off from rest of aperture, umbilicus slight or absent, outer lip sometimes plicate internally. Periostracum thin, smooth. 28 × 11·5–12 mm.

Operculum (*burnupi*) ovate, apex incurved, 6 × 3 mm. in 28 mm. shell.

Rufous with white apex, and a pale band below centre of body whorl, aperture rufescent within (*alboapicatus*); white with brown periostracum, the strong lira on base showing as a pale line, aperture rosy or purplish within, operculum dark brown (*burnupi*) (see Remarks).

Dead: (*alboapicatus*) Durban (Tomlin). Living: (*burnupi*) Port Shepstone (Natal) (Smith, also S. Afr. Mus. Ross-Frames coll. ex Burnup).

Remarks. Although Smith must have had his *alboapicatus* for comparison when he described *burnupi*, and Melvill accepted both species, I strongly suspect

that the two are conspecific. As I have seen no specimens of the former species, the description is based mainly on specimens of *burnupi* collected in the type locality by Burnup.

Like Smith's specimens, all these are more or less corroded at the apex, so that the true size of the protoconch or the sculpture of the 1st whorl cannot be determined.

Tomlin (1931) records (*fide* Burnup) a specimen of *alboapicatus* 44 (45) × 16·5 mm. (!), of which Burnup said the ribs and growth-lines were paler than the intervening spaces, and the spiral grooves much darker than the lirae. This applies also to Burnup's specimens of *burnupi* in S. Afr. Mus.

Gen. Peristernia Mörch

1852. Mörch. *Cat. Conch. Yoldi.*, i, p. 99.
1891. Melvill. *Mem. Manch. Philos. Soc.* (4), iv, p. 365 (*Latirus* part).
1911. id. *J. Conch.*, xiii, p. 164 (*Latirus* part).
1935. Yen. *Notes Malac. Chinoise*, i (2), p. 41 (*Peristerina* emend.).

Shell broadly fusiform, more or less distinctly axially ribbed and spirally lirate, the lirae often scabrous or squamose; not or only slightly umbilicate, canal moderate, slightly recurved, columella usually with 2 pleats, aperture internally plicate. Operculum as in *Latirus*.

Radula: central plate piriform, narrowed in front, with 3 feeble cusps, and lateral plate with denticles between the main cusps.

Included conchologically in *Latirus*, by Melvill, but can be distinguished by the radula.

Peristernia leucothea Melv.

Fig. 19(*e*)

1891. Melvill. loc. cit., p. 399, pl. 2, fig. 15.
1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 1, pl. 1, fig. 2 (*Euthria eburnea*).
? 1932. Turton. *Mar. Sh. Pt. Alfred*, p. 54, pl. 12, no. 400 (*Euthria ordinaria*).
1937. Peile. *J. Conch.*, xx, p. 300, fig. 1 (radula).

Length about twice breadth. Aperture subequal to spire. Protoconch $1\frac{1}{2}$ whorls, diam. 0·8, alt. 0·75 mm., smooth, 2 riblets close together before junction with 1st postnatal whorl. Postnatal whorls 7; axial ribs 9–10 on 1st whorl, increasing to 11–12 on last whorl, from suture to suture but more prominent peripherally, evanescent on base; crossed by spiral lirae, 3 on 1st and 2nd whorls, 4 on 3rd, 5–6 on 4th, increasing to 10–11 on last whorl, often with intermediaries, 10–12 additional on base, also with intermediaries, usually one or two at about the middle of base stronger than the others; fine close-set growth-lines producing punctae in the sulci between the lirae. Parietal callus present, columella with 3 pleats but usually only 2 or one distinct, forming a short keel at beginning of the short canal. Outer lip internally plicate, the 1st

(posterior) and last (opposite columella pleat) plicae larger than the others, more or less dentiform. Columella glaze sometimes rimate anteriorly forming a feeble umbilicus. Periostracum very thin. 25 × 12 mm.

Operculum ovate, apex incurved, 4·5 × 2·5 mm. in 22 mm. shell, internal surface as in *Fasciolaria*.

Creamy-white or pale buff, unicolorous; or orange-brown with markings, the colour when present is mostly around the suture, between the ribs, and in one or two bands on base, aperture internally white or pale brown, or pale violaceous, operculum chestnut-brown, periostracum yellowish-brown.

Radula with 250–270 rows, lateral plates with 9–11 (12) cusps and denticles, not always symmetrical and the sequence of cusps and denticles varying from one part of the radula to another.

Dead: Port Natal (Durban) (Melvill), Isipingo and Umkomaas (Natal) (Smith), Tongaat (Natal) (S. Afr. Mus.); Pondoland (Sowerby: *eburnea*); Port Alfred (Turton: *ordinaria*).

Living: off Durnford Point (Zululand) 13 fathoms (S. Afr. Mus. P.F. coll.); Scottburgh (Natal) littoral (S. Afr. Mus. coll. K.H.B.); Umpangazi, Umhlali, Durban, Umtwalumi, Port Edward and Port St. Johns (U.C.T.).

Remarks. The apex is usually corroded in littoral specimens; only one of the numerous Scottburgh specimens had a complete unworn protoconch.

Appears to be an 'albino' form of *nassatula*, as there is no conchological difference between the two. Of the specimens I have seen, those most strongly marked with orange-brown come from Umhlati, Tongaat, and Durban. Others from the last locality are uniform white or buff; one of the Umpangazi shells has a pale violaceous aperture. For the present retained separate from *nassatula*.

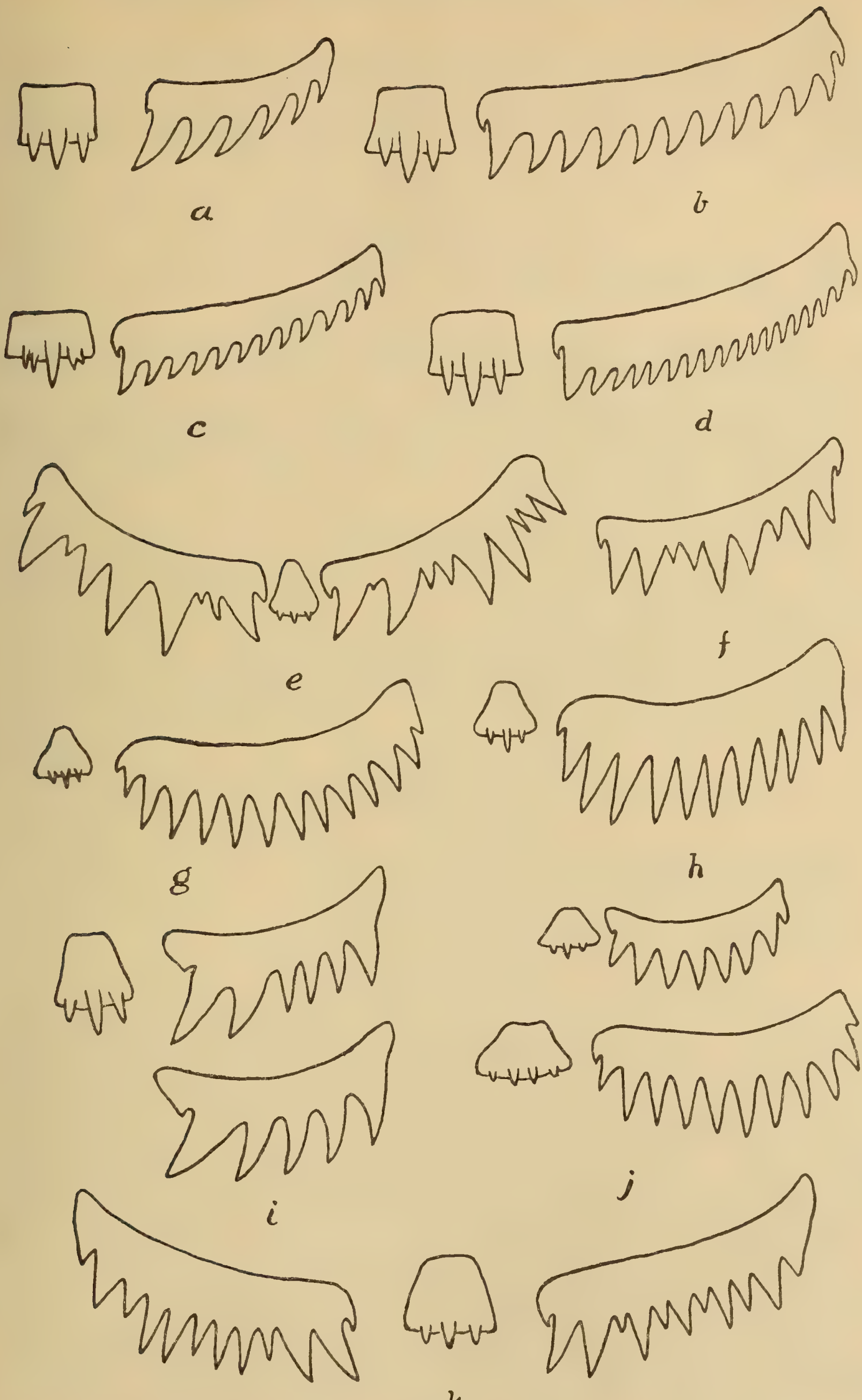
One specimen with an aberrant operculum: oval, nucleus intramarginal in apical third of length.

A series of water-worn specimens (S. Afr. Mus. locality?) is interesting. The effect of wear is to broaden the ribs and reduce the intervening grooves in which the spiral lirae, or their intervening sulci, persist, though much reduced. Even when completely worn away at the upper part of a whorl, they usually persist in the lower part adjoining the suture of the following whorl. The final result—a perfectly smooth shell—appears to be represented by Turton's *ordinaria* from Port Alfred, the locality farthest removed from the habitat of the living animal.

Even badly worn specimens, however, are too broad to be mistaken for *fuscotincta*.

FIG. 19. ——→

Central and lateral radula plates of (*a*), (*b*) *Fasciolaria lugubris* Rve. from juvenile from egg-capsule, and from 85 mm. shell; (*c*) *F. rutila* Watson; (*d*) *F. heynemanni* Dnkr.; (*e*) *Peristernia leucothea* Melv.; (*f*) *P. fuscotincta* (Sow.); (*g*) *Fusus verruculatus* Lam.; (*h*) *F. faurei* n. sp.; (*i*) *F. rubrolineatus* Sow., two variants of lateral plates; (*j*) *F. colus* Linn., half-grown and adult, the latter with abnormal 4-cuspid central plate; (*k*) *F. africanae* n. sp.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P. incarnata Desh., recorded from Natal (Sowerby 1892) (occurs also at Mauritius, Red Sea, and Indo-Pacific) differs from *leucothea* in having fewer spiral lirae on last whorl (6–7 in Philippine specimens in S. Afr. Mus.), and in coloration, which is yellow or orange with brown intervals between the ribs.

Peristernia nassatula (Lam.)

1859. Chenu. *Man. Conchyl.*, i, fig. 910.
1880. Von Martens. *Mauritius & Seychellen*, p. 246 (*Plicatella n.*).

The description given for *leucothea* will apply to this species which is, however, more brightly coloured.

Cream, upper half of whorls and the grooves between the ribs brown, shading off into orange-brown, base with a pale spiral band at level of top of aperture, followed by a dark brown band and then another pale band, rostrum orange-brown, aperture violaceous.

Radula (one specimen from Delagoa Bay examined) incomplete but with at least 180 rows, lateral plate with (8) 9–10 cusps and denticles, varying in size and sequence as in *leucothea*.

Natal (Krauss, ? dead). Delagoa Bay, living (U.W.).

Distribution. Mauritius, Réunion, Seychelles, East Indies.

Peristernia fuscotincta (Sow.)

Fig. 19(*f*)

1886. Sowerby. *J. Conch.*, v, p. 2 (*Euthria f.*).
1889. id. ibid., vi, pl. 1, fig. 18.
1892. id. *Mar. Sh. S. Afr.*, p. 4, pl. 1, fig. 13 (*Euthria f.*).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 99, fig. 36 (radula).
1947. Stephenson. *Ann. Natal Mus.*, xi, pp. 271, 273 (*Cominella f.*).

Length distinctly more than twice breadth. Aperture shorter than spire. Protoconch 2 whorls (all specimens worn). Postnatal whorls 5; faint indications of weak ribs on upper 2 or 3 whorls; all whorls with spiral grooves, 4 on 2nd whorl increasing to 10–11 on last whorl, usually in pairs, and punctate where crossed by the growth-lines, 9–10 additional on base, some in pairs. Parietal callus present, columella with 3 pleats, but only one or two distinct, forming a short keel at beginning of the short canal. Outer lip internally plicate, 1st and last plicae larger than the others. Sometimes a feeble umbilicus. 20 × 8 mm.

Operculum oval, apex incurved.

White with irregular brown markings, either as patches or axial flames, usually a more or less continuous brown band below periphery.

Radula with 140–160 (Peile: 167) rows, lateral plate usually with 6 major cusps with intervening denticles (1 or 2); the arrangement varies in successive rows, and is not always symmetrical on the two sides (cf. *leucothea*).

P. fuscotincta: dead; Port Elizabeth, Port Alfred (Sowerby, Bartsch, Turton); Port Shepstone (Natal) (S. Afr. Mus. coll. Burnup).

Living: Port St. Johns to Richmond (Alexandria Division) (Stephenson); East London to Kleinmond (Bathurst Division) (U.C.T.).

Remarks. In *fuscotincta* the spiral grooves were described as very obscure (they certainly are in beach-worn specimens!).

Some of the beach-worn specimens in S. Afr. Mus. are almost wholly white, but even so the subperipheral band and a few brown marks are just visible.

Stephenson (1947 p. 271 footnote) transferred this species to *Cominella* (*Afrocominella*) seemingly at Tomlin's suggestion—a clear case where conchological guessing proved wrong—although Peile's examination of the radula had already (1938) put the species in its correct genus.

Gen. Fusus Brug.

1789. Bruguière. *Encycl. Meth.* (1), xv.

Shell more or less elongate-fusiform spire often high. Canal moderately or very long; columella without pleats but sometimes rimate.

Operculum oval or piriform apex blunt more or less incurved or sharply pointed, nucleus apical, internal surface with marginal thickening as in *Fasciolaria.*

Radula, central plate subtriangular, narrowed in front, tricuspid, lateral plate with several cusps, without intermediate denticles.

Remarks. *F. radialis* Watson has proved, not unexpectedly, to be a *Columbarium* (p. 234), and *F. speratus* a *Tritonalia* (p. 215).

Fusus africanus (Sow.)

1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 1, pl. 6, fig. 19.
1903. Smith. *Proc. Mal. Soc.*, v, p. 368, pl. 15, fig. 19.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 50, pl. xi, no. 370 (*kowiensis*).

Piriform. Aperture (excl. canal) a little longer than spire (incl. canal: $2\frac{1}{3}$–$2\frac{1}{2}$ times spire). Profile of early whorls nearly straight, of later whorls angular. Protoconch 2 whorls, smooth (but no perfect specimen seen). Postnatal whorls 6; on first 3 whorls 10–11 very obscure axial ribs, reduced on following whorls to peripheral rounded knobs, which become stronger on last 2 whorls: on 4th whorl near suture, on 5th and 6th nearer middle of whorl; crossed by spiral lirae, 5 on 1st whorl, increasing to 8–9 (10) on 4th whorl but thereafter evanescent; on base 12–15 low blunt costae, evanescent towards end of rostrum. A blunt parietal callus, columella curved, glaze discrete forming an umbilical rimation; canal long, straight, narrow, distinctly marked off from

rest of aperture; outer lip not plicate within. Periostracum thin. 104 × 52 mm. (Turton); 79 (protoconch missing) × 38 mm. (S. Afr. Mus.).

Operculum and radula unknown.

Creamy, buff, pale orange-brown, with darker marks between the knobs and sometimes axial flames, grooves between costae on base orange-brown, periostracum brown.

Port Elizabeth (Sowerby); Port Alfred (Turton: *kowiensis*); off Durban [from fish stomachs] (Smith, also S. Afr. Mus.).

Remarks. Only dead specimens known. Except for Sowerby's original young specimens, and Turton's specimen, this species has only been obtained from fish stomachs in Natal waters. Not taken by the *Pieter Faure*.

Fusus verruculatus Lam.

Figs. 19(*g*), 20(*a*)

1816. Lamarck. *Tabl. Encycl. Meth.*, p. 429, fig. 7, and Liste, p. 7 (*ocelliferus*, name and figure only).
1822. Id. *Anim. sans Vert.*, vii, p. 129.
1870. H. Adams. *Proc. Zool. Soc. Lond.*, p. 110, text-fig. (*ventricosus*, non Gray).
1876. Kobelt. *Conch. Cab.*, p. 152, pl. 47, fig. 3 (*adamsii*).
1886. Watson. *Challenger Rep.*, xv, p. 195 (references).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 3 (*robustior*).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 184, pl. 32 (20), fig. 19 (juv. referred with ? to *capensis* Thiele).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 50 (*ocelliferus* and *robustior*), pl. xi, no. 369 (*robustior* juv.).

Aperture (incl. canal) $1\frac{1}{3}$ to nearly $1\frac{1}{2}$ times spire. Profile of early whorls slightly angular, of later whorls angular (with knobs) (*verruculatus*), convex (*adamsii*). Protoconch $2\frac{1}{2}$ whorls, diam. and alt. 1·5–1·75 mm. (rarely perfect except in juv.), smooth but with some irregular plicae before the abrupt junction with 1st postnatal whorl. Postnatal whorls 8; axial ribs 9–10 on 1st whorl, increasing to 11, usually from suture to suture on first 3 whorls, but thereafter only at periphery where they become blunt, more or less complanate knobs, 11–15 in number, continuing on to 8th whorl forming a prominent shoulder in typical *verruculatus*, but petering out on 7th or 8th whorl in *adamsii*; crossed by spiral lirae, 3 (4) on 1st whorl, increasing to 5 (6) on 2nd and 3rd whorls, 2nd and 3rd lirae strongest, thereafter the 3rd strongest, on the periphery and carrying knobs, i.e. 2 lirae above and 2 (sometimes 3) below the peripheral keel; 15–20 additional lirae on base, with intermediaries; also over the whole whorl fine spiral striae. Parietal callus not strong, sometimes in addition with 3–4 (up to 6) plicae; columella curved, rimate in half-grown to adult examples, forming a deep but narrow umbilicus. Canal nearly straight in juv., usually more strongly curved in older examples, subequal to and not sharply marked off from rest of aperture. Outer lip at some stages of growth plicate within. Periostracum thin, fibrous and imbricate, especially near the suture, fimbriate.

(*verruculatus*) 150 (protoconch and tip of rostrum broken, say: 153) × 70 mm.; 119 × 45 mm.; (*adamsii*) 133 × 48 mm.; 125 × 50 mm.

Operculum oval, apex incurved, 35 × 18 mm. in 125 mm. shell.

Cream or buff, the peripheral knobs usually reddish-brown, sometimes also indications of orange flames, periostracum greyish or yellowish-brown, operculum horny or reddish-brown; juveniles seem to be more brightly coloured (at least in some beach-worn examples the coloration shows better), with darker knobs and flames.

Animal bright red with minute white specks (K.H.B.).

Radula in 7 mm. shell with 110 rows, lateral plate with 7 cusps, in 23 mm. shell resp. 165 and 8, in 25 mm. shell resp. 170 and 8, in 30 mm. shell resp. 205 and 9, in 38 mm. shell resp. 215 and 9, in 62 mm. shell resp. 230 and 11–12, in 114 mm. shell resp, 285 and 12, in 150 mm. shell resp. 325 and 13 (the tiny denticle at inner end excluded in all counts).

Dead and beach-worn specimens recorded from Port St. Johns, Port Alfred, Port Elizabeth, Agulhas Bank, Still Bay, False Bay (Sowerby, Adams, Bartsch, Turton and S. Afr. Mus.).

35° 16′ S. 22° 26′ E., 155 metres (Thiele, juv.).

Living: Simon's Bay (False Bay), 15–20 fathoms (Watson); Algoa Bay and Agulhas Bank to mouth of False Bay, 10–66 fathoms (S. Afr. Mus. P.F. coll.). Sea Point (Cape Town), low tide (S. Afr. Mus.), Knysna, low tide (S. Afr. Mus. P.F. coll.). Both the latter *adamsii* form). 33° S. 28° 11′ E. (off East London), 31 fathoms (*verruculatus* form) (U.C.T.).

Saldanha Bay, 10–14 fathoms (S. Afr. Mus. P.F. coll.).

34° 35′ S. 19° 14′ E., 66 metres; False Bay, 3–24 metres; west coast of Cape Peninsula, intertidal; Langebaan (Saldanha Bay); off Lambert's Bay, 66 metres (U.C.T.).

Remarks. The East London locality bridges the gap between Port St. Johns and Port Alfred.

The *verruculatus* and *adamsii* forms are not restricted to separate areas.

Juveniles from 5 mm. long (protoconch plus 1st whorl) examined.

While the early whorls show little variation, the later whorls show marked dimorphism: the typical *verruculatus* with strong shoulder knobs, and *adamsii* with evanescent knobs and evenly convex whorls. The institution of *adamsii* as a distinct species is not surprising when only the extreme forms were available. But they are connected by transitional forms.

Plump and slender examples occur in both *verruculatus* and *adamsii*, though the latter in general is the more slender. The most slender specimen I have seen is one (*adamsii*) taken in False Bay measuring 118 × 40 mm.; it is not scalariform but the spire is elongated to such an extent that its length equals the length of aperture (incl. canal).

In the early whorls the axial ribs are usually well developed (see Thiele's figure), and the bicarinate periphery on the 2nd and 3rd (sometimes also but less conspicuous on 4th) whorls is very characteristic.

One specimen (S. Afr. Mus. no. A4661, off Cape St. Blaize) 82 mm. long, and a juvenile (locality ?) 20 mm. long, have unusually large protoconchs: diam. and alt. almost 2·3 mm.

Another specimen, also from off Cape St. Blaize, 147 × 57 mm., has peripheral knobs extending on to the 8th whorl but the profile is convex, not shouldered; and the canal is markedly sigmoid.

One specimen (S. Afr. Mus. no. A4662, off Cape St. Blaize) 137 (tip of canal broken, probably 140–142 when perfect) × 66 mm., is subscalariform, with strongly convex ventricose whorls, and deeply sunken sutures.

It is a question whether the name *ocelliferus* in Lamarck's *Liste des objets* (sometimes attributed to Bory, but see: Sherborn & Woodward. *Proc. Zool. Soc. Lond.*, 1893, p. 584) should be used for this species. The figure is recognizable as a representation of this species, but is it adequate to distinguish it from other species?

Fusus colus Linn.

Figs. 19(*j*), 20(*b*)

1816. Lamarck. *Tabl. Encycl.*, pl. 423, fig. 2, and Liste, p. 6 (*longicauda*).
1859. Chenu. *Man. Conchyl.*, i, fig. 597.
1876. Kobelt. *Conch. Cab.*, p. 146, pl. 30, fig. 3, pl. 47, fig. 1.
1942. Gravely. *Bull. Madras Govt. Mus.*, V, 2, p. 62, fig. xi, i (*longicauda*).
1952. Satyamurti. ibid., n.s. I, 2 (6), p. 187 (*longicauda*).

Protoconch $2\frac{1}{2}$ whorls, diam. 1, alt. 1·3 mm., smooth, with a dozen or more fine axial ribs in last half whorl, which is more or less sharply demarcated from 1st postnatal whorl.

Radula in 25 mm. shell with 80 rows, lateral plate with 8 cusps, in 40 mm. shell resp. 140–170 and 8–9, in 97 mm. shell *c.* 220 and 11 (excl. the minute inner denticle); central plate broader than long, narrowed in front, tricuspid (in one specimen 4-cuspid).

Living: off Umhloti and Umvoti Rivers (Natal), 25–27 fathoms; off Amatikulu River (Zululand), 24 fathoms (S. Afr. Mus. P.F. coll.). Delagoa Bay (S. Afr. Mus. coll. K.H.B., and U.W.). Inhambane (U.C.T.).

Dead: off Tongaat and Umhlanga (Natal), 22–36 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. F. toreuma (Martyn), recorded from Natal by Smith (1903), is distinguished by the angular profile of the whorls. If the Natal specimen was taken from a fish stomach, the species is probably living in South African waters.

Fusus torulosus Lam.

1816. Lamarck. *Tabl. Encycl. Meth.*, pl. 423, fig. 4, and Liste, p. 6.

Specimen in S. Afr. Mus., probably from Ceylon or Indian Ocean. Aperture (incl. canal) longer than spire. Protoconch missing. Postnatal

whorls 10; profile convex with crenulations due to the spiral lirae. Axial ribs 5–6 on 1st and 2nd whorls, increasing to 10–11 on last, broad and rounded, from suture to suture; crossed by sharp spiral lirae 4–5 on 1st whorl, increasing to 10–11 on last, with an intermediary between the peripheral pair; *c.* 35 additional lirae on base and rostrum, some of them feebler than others. Growth-lines distinct immediately below suture, more or less so between the lirae on rest of whorl. Sutures deep. 91 (protoconch missing) × 24 mm.

A fragment of two half whorls exactly agreeing with the sculpture of the above described specimen: off Cape Natal, 85 fathoms; off Umhloti River, 40 fathoms, 2 worn fragments; off O'Neil Peak (Zululand), 90 fathoms, one worn fragment (S. Afr. Mus. P.F. coll.).

Fusus rubrolineatus Sow.

Fig. 19(*i*)

1870. Sowerby. *Proc. Zool. Soc. Lond.*, p. 252.
1880. id. *Thes. Conch.*, iv, p. 80, pl. 411, fig. 68.
1903. id. *Mar. Invest. S. Afr.*, ii, p. 228.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 30.
1903. Thiele. ibid., p. 169, pl. 9 (4), fig. 60 (radula).
1915. Bartsch. *Bull U.S. Nat. Mus.*, 91, p. 47.

Aperture (incl. canal) 1–1¼ times spire. Protoconch 2½ whorls, diam. and alt. 1·2 mm., smooth, with 4–6 axial ribs on last half whorl, junction with 1st postnatal whorl distinct. Postnatal whorls 7; axial ribs 14–15 on 1st whorl, increasing to 17–18 on last whorl, from suture to suture, but evanescent towards suture on last whorl and on lower half of base, from about the 4th whorl slightly curved below the suture; fine close-set growth-lines; crossed by 3 spiral lirae which appear alone on 1st whorl and continue as 3 main lirae on all following whorls but with added intermediaries (e.g. on 6th whorl 6–7 between suture and 1st main lira, 3 between 1st and 2nd, and between 2nd and 3rd, 3–4 below 3rd lira); 15–20 additional lirae on base, those on upper half with intermediaries; main lirae on the whorls and upper half of base forming horizontal complanate nodules at intersections with axial ribs. No parietal callus, columella slightly curved, in some specimens with a slight swelling (scarcely a pleat) at the bend. Canal shorter than, but not marked off from rest of aperture, slightly curved. Periostracum thin, smooth. 38 × 13 mm., a plump specimen 32 × 13 mm.

Operculum broadly oval, apex rounded, slightly on *outer* side of median line (von Martens said toward inner side), 6 × 4 mm. in 35 mm. shell, internal surface as in *Fasciolaria*.

Pale buff, main lirae on whorls and base, and also some of the more prominent intermediaries orange-brown, forming spiral lines, usually continuous but often more intense on the axial ribs, producing an effect of series of spots or axial flames.

Radula with 150–180 rows, central plate longer than wide, narrower in front, with 3 rather strong cusps, lateral plate with 5–6 cusps (excl. inner denticle), varying in size, and often asymmetrical.

Agulhas Bank (Sowerby 1870); 35° 16′ S. 22° 26′ E., 155 metres (von Martens); off Cape St. Blaize, 53 fathoms (Sowerby 1903).

Living and dead: Agulhas Bank, from approximately 22° E. to 27½° E., and southwards to Brown's Bank approx. 36½° S., 63–124 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. Von Martens (loc. cit. 1903. p. 103, pl. 2, fig. 10) described *rufinodis* from off Zanzibar and Sumatra, and compared (p. 104) it with *rubrolineatus*. But he seems to have compared his specimens with Sowerby's figure instead of with actual specimens of *rubrolineatus* which were available to him. The differences are not very convincing and the two species are obviously closely allied. *F. rufinodis*, however, has only 10 axial ribs on the 7th (penultimate) whorl and 11–12 on the 8th whorl; and the central plate of the radula (Thiele, loc. cit., fig. 59) is nearly square.

An even more closely allied species is *F. libratus* Watson 1886 from Fiji Islands, 315 fathoms.

Most of the *Pieter Faure* examples are, like the *Valdivia* specimens, covered with an Alcyonarian.

Fusus faurei n. sp.

Figs. 19(*h*), 20(*e*)

Aperture (incl. canal) 1⅓ times spire. Profile of whorls convex, slightly biangulate. Protoconch 2 (2½) whorls, diam. and alt. 2 mm., smooth (but all specimens more or less corroded). Postnatal whorls 6; axial ribs 11–12 on 1st whorl, increasing to *c.* 18–20 on last whorl (irregular and obscure on last half whorl), low, rounded not prominent except at the 2 peripheral lirae, slightly retractive below suture; crossed by 2 main peripheral costae from 1st whorl onwards, with finer lirae above and below, on last whorl 6–7 above and 3–4 below the peripheral costae, varying in strength, the lowest one (next the suture) the strongest, 2–3 between the 2 costae, 15–20 additional lirae on base, usually an intermediary between each pair. No parietal callus. Columella gently curved, no pleats, not rimate. Canal a little shorter than, and distinctly but not sharply marked off from rest of aperture, straight or very slightly reflexed at tip, open. Periostracum thin. 50 (protoconch and tip of canal broken) × 22 mm.; 33 × 15 mm.

Operculum oval, apex blunt, incurved, 9 × 5 mm. in 38 mm. shell.

Creamy-white, periostracum grey, operculum amber-brown.

Radula with at least 180 rows, central plate narrowed in front, tricuspid, lateral plate with 11 cusps (excl. inner denticle).

Living and dead: off Cape Point, 300–560 fathoms (S. Afr. Mus. A4581 (Type), A4582. P.F. coll.).

Fusus bonae-spei n. sp.

Fig. 20(*c*), (*f*)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 183, pl. 32 (20), fig. 18 (*capensis*, non Dunker). Not the juv., p. 184, fig. 19 = *verruculatus*.

Aperture (incl. canal) a little longer than spire. Profile of whorls convex but weakly biangulate. Protoconch $2\frac{1}{2}$ whorls, when not corroded diam. 2 mm., alt. 2·5–3 mm., smooth, junction with 1st postnatal whorl abrupt. Postnatal whorls 7; feeble axial ribs 8–9 on 1st whorl, increasing to 9–10, but not traceable beyond 4th whorl; growth-lines distinct; crossed by spiral lirae, on 1st whorl 3, the lower two stronger than the upper one, continued on following whorls, the two stronger ones forming the periphery, with weaker intermediaries producing a fine cancellate sculpture, 20–25 additional lirae on base also with intermediaries. No parietal callus, columella slightly curved,

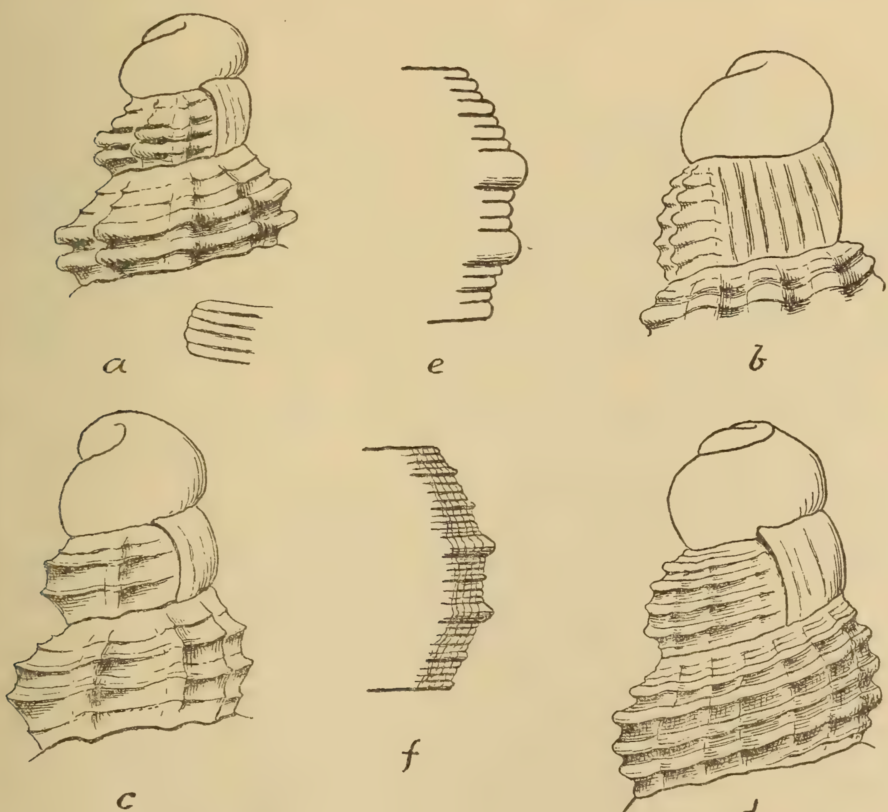


FIG. 20.

(*a*) *Fusus verruculatus* Lam., protoconch, with detail of one lira. (*b*) *F. colus* Linn. protoconch. (*c*) *F. bonae-spei* n. sp. protoconch. (*d*) *F. africanae* n. sp., protoconch. (*e*) *F. faurei* n. sp., profile. (*f*) *F. bonae-spei* n. sp., profile.

canal $1\frac{1}{4}$–$1\frac{1}{3}$ times, but not very sharply marked off from rest of aperture, straight or slightly curved and reflexed, narrow. Outer lip not plicate internally. Periostracum thin, fibrous-fimbriate. 102 × 34 mm.

Operculum oval, apex incurved, 20 × 12 mm. in 102 mm. shell, internal surface as in *Fasciolaria*.

Creamy-white or pale buff, periostracum yellowish-buff, operculum brown.

Dead: 34° 33′ S. 18° 2′ E., 318 metres (Thiele).

Living and dead: off Cape Point, 85–256 fathoms (S. Afr. Mus. A4622, A4628–32, Type A4632. P.F. coll.).

Remarks. I have not seen Dunker's description or figure, but it seems most improbable that Thiele's *capensis* is the same. Krauss gave the dimensions of Dunker's species as 10 × 5·2 lines.

Although there are eight specimens in S. Afr. Museum with their opercula, no animal has been preserved.

Fusus africanae n. sp.

Figs. 19(*k*), 20(*d*)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 184, pl. 32 (20), fig. 20 ('*Fusus* n. sp.', *sine nom.*).

The *Valdivia* specimen from 35° 16′ S. 22° 26′ E., 155 metres, measured 22·5 × 9 mm. and consisted of a large protoconch and 3 whorls. The profile of the whorls is evenly convex, without the bicarinate periphery of juvenile *verruculatus* and *bonae-spei*. Thiele was therefore correct in regarding it as a distinct species. Unfortunately he did not state the number of ribs and spiral lirae; judging by his figure there might be 13 or 14 ribs and 4 or 5 lirae on the 2nd and 3rd whorls.

The *Pieter Faure* obtained two smaller specimens, 15 × 6·5 mm.; one in 1900 from off west coast of Cape Peninsula, 131–136 fathoms, and another in 1906 from Brown's Bank (approx. $36\frac{1}{2}$° S. 21° E.), 80–100 fathoms (S. Afr. Mus. nos. A8826 and A8610 Type).

Aperture (incl. canal) a little longer than spire. Protoconch $2\frac{1}{2}$ whorls, diam. 3, alt. 2·75–3 mm., smooth, with 2–3 feeble growth-lines (scarcely ribs) on outer lip. First postnatal whorl beginning abruptly, and not quite flush with outer lip of protoconch; 14 low feeble axial ribs on 1st and 15 on 2nd whorl (slightly irregular in A8826 owing to injury), 3rd whorl incomplete; crossed by 4 spiral lirae of nearly equal strength (the uppermost one slightly weaker) on 1st and 2nd whorls, a finer one between 1st lira and suture, and indications of a fine intermediary between each pair of main lirae (more distinct in A8826 than in A8610), also a lira below the 4th but partly obscured by suture of following whorl; intersections very slightly nodulose; on base of last whorl *c.* 10 main lirae, with finer intermediaries. Columella curved, no visible pleats, canal slightly curved, a little longer than rest of aperture.

Operculum oval, apex incurved, 3·5 × 2 mm.

The Fisheries Survey vessel *Africana* obtained (1948) a larger example 52 × 17 mm., from 34° 35′ S. 19° 14′ E., 66 metres (AFR. 864 E.).

Protoconch 2½ whorls, diam and alt. 3 mm., smooth, with 2–3 feeble lines of growth on outer lip. Postnatal whorls 5; 1st beginning abruptly and not quite flush with outer lip of protoconch; axial ribs on 1st whorl obscure, possibly 14, on 2nd whorl 15 (16) also feeble, on 3rd whorl 16 (17), on 4th 17 (18), thereafter evanescent; crossed by predominant spiral lirae, 5 on 1st whorl, the lower 3 strongest, a finer one between 1st lira and suture, and below the 5th another partly obscured by suture of following whorl; on 2nd and following whorls 6 lirae, the 3 lowest strongest on 2nd and 3rd whorls, the 4 lowest on 4th and 5th whorls, one fine intermediary between each pair of stronger lirae; on base of last whorl 12 (and some obscure ones on rostrum) additional lirae with fine intermediaries; lirae on later whorls distinctly flattened. A small dentiform parietal callus, no visible columella pleats.

Operculum oval, apex incurved, 9 × 6 mm.

Protoconch glistening white, shell greyish-white, operculum horn coloured.

A very thin periostracum obscured by a thin layer of sponge; and with numerous oval horny capsules (maj. diam. 0·5 mm.) glued firmly to the shell (not belonging to this species, or any other Fasciolariid as they are not stalked).

Radula with *c.* 190 rows, central plate tricuspid, lateral plate with 11 cusps (excl. the tiny inner denticle), the innermost 2 strong, the others alternately smaller and larger, the 10th cusp rather strong and the outermost one the smallest; the arrangement is not quite symmetrical on the two sides, nor on successive plates on the same side, particularly so on the left side; the right side as shown in fig. 19(*k*) seems to be the most usual arrangement.

Radula of the two juv. P.F. specimens with 105–110 rows, lateral plate with 5 unequal cusps.

Remarks. The *Africana* specimen is separately described to show the slight difference in detail of the spiral lirae; viewing it side by side with the other two there is no doubt they are conspecific; and there seems little doubt that they are the same as the *Valdivia* example.

The 25 mm. shell in bad condition figured by Thiele (loc. cit., fig. 19) from the same locality has a smaller protoconch and seems to be referable to *verruculatus*.

The four known examples are all from moderate depths on the southern and south-western slopes of the Agulhas Bank, and it is surprising that no others have been obtained. From the size of the protoconch one would suspect an adult at least as large as *verruculatus*.

The radulae of all three specimens are remarkable for the inequality of the cusps on the lateral plate, especially noticeable in the large *Africana* specimen, thus resembling the radula of *Peristernia* more than that typical of *Fusus*.

Fusus albinus A. Adams

1855. A. Adams. *Proc. Zool. Soc. Lond.*, p. 222.
1880. Sowerby. *Thes. Conch.*, p. 80, pl. 7 (411), fig. 72.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 9, pl. 2, fig. 9 (*appressus*).
1903. Thiele. ibid., p. 169, pl. 9 (4), fig. 61 (radula) (*appressus*).
1912. Dautzenberg. *Ann. Inst. ocean.*, V, pt. 3, p. 28.

Adams described 'a large white solid species with moderately long beak, and with longitudinal rounded rib-like plicae which are obsolete at the sutures' from Ichaboe Island, north of Lüderitzbucht.

Von Martens compared his species, 101 × 40 mm. from Great Fish Bay (Angola), 16 fathoms, with *albinus*, but concluded that the two were distinct.

Dautzenberg recorded *albinus* from Mossamedes, 15–20 metres, and Praya Amelia, 15–35 metres, but made no mention of *appressus*.

? *Fasciolaria holcophorus* n. sp.

Fig. 21

Fusiform, aperture subequal to spire. Profile of whorls convex, without shoulder. Protoconch 1½ whorls, diam 0·6, alt. 0·5 mm., smooth, with 4 or 5 faint axial ribs on last half whorl, junction with 1st postnatal whorl indistinct. Postnatal whorls 5; axial ribs 10–11 on 1st whorl, 8 on 2nd, 7 on each of the 3rd, 4th and 5th whorls, from suture to suture and strong on early whorls, but from later part of 4th whorl becoming feeble and causing mere undulations on the periphery of 5th whorl, obsolete on base; crossed by spiral striae, 4 on 1st whorl, 7 on 2nd, 8 on 3rd, 9 on 4th and 10 on 5th, about 16 additional on base, those on rostrum almost parallel with the canal, all striae regularly spaced except 2 or 3 fine intermediaries on base. Columella gently curved, with 3 pleats, the lowest one feeble. Canal straight (tip broken). Periostracum thin, smooth. 11 × 4 mm.

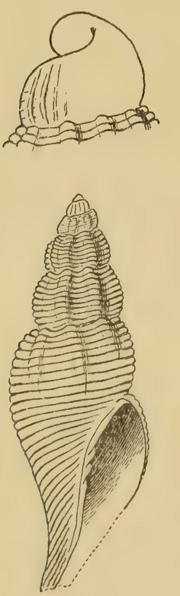


Fig. 21. *Fasciolaria* ? *holcophorus* n. sp.

White, periostracum pale buff.

Off Cape St. Blaize, 125 fathoms, 1 dead (S. Afr. Mus. no. A8819. P.F. coll.).

Remarks. In the absence of the radula the generic position of this pretty little shell is quite uncertain. There is a somewhat fanciful resemblance to *Ptychatractus*, which Thiele (1929) removed from the *Fasciolariidae* to the *Vasidae*.

Fam. *NASSIDAE*

Gen. Nassa Lam.

1799. Lamarck. *Mem. Soc. H. N. Paris*, p. 71 (non *Nassa* Bolten, 1798).
1806. Duméril. *Zool. Analyt.*, p. 166 (*Nassarius*).

1916. Iredale. *Proc. Mal. Soc.*, xii, p. 82 (*Nassarius*).
1928. Tomlin. *Ann. S. Afr. Mus.*, xxv, p. 313 (*Nassarius*).
1929. Thiele. *Handbuch*, i, p. 322 (incl. *Desmoulea* [*sic*]).
1931. Lebour. *J. Mar. Biol. Assoc.*, xvii, p. 797 (eggs and larva).
1936. Peile. *Proc. Mal. Soc.*, xxii, p. 139 (radula).
1939. id. ibid., xxiii, p. 276 (radula).

Remarks. Neither *Nassarius* Duméril 1806 nor *Nassaria* Link 1807 (*Buccinidae*) are to be rejected on account of the similarity of their termination (Rules Zool. Nomencl. Art. 36. Rec.), though Iredale thought otherwise; but as they are very liable to confusion, no apology is made for reverting to *Nassa* Lam; Thiele accepted it, several years after Iredale's proposed alteration; and everyone knows the distinctive facies of a 'Nassa'. As regards subgenera, until some agreement is reached on their definition, they are better ignored, at least so far as South African species are concerned. These are all typically 'Nassa', with the one exception of *kraussiana*, the radula of which is also distinctive.

South African 'beach-conchology' has run rampant in this genus; and when once a species has acquired synonyms it seems to attract more synonyms, e.g. *capensis* and *kochiana* (cf. Tomlin). Most of Turton's 'n. spp.' will probably prove to be synonyms, but without actual examination of his material one can only suggest possible or likely synonymy. He took no notice of Tomlin's 1928 paper.

Nassa analogica Sow.

Fig. 22(*a*)

1853. A. Adams. *Proc. Zool. Soc. Lond.* (for 1851), p. 113 (*trifasciata*, non Gmelin).
1903 (8th July). Sowerby. *Mar. Invest. S. Afr.*, ii, p. 219, pl. 4, fig. 3.
1903. id. ibid., p. 228, pl. 4, fig. 2 (*trifasciata* Adams).
1903 (18th Dec.). Von Martens. *D. Tiefsee Exp.*, vii, p. 27, pl. 3, fig. 18 (*circumtexta*).
1903. Thiele. ibid., p. 167, pl. 9 (4), fig. 52 (radula) (*circumtexta*).
1906. Smith. *Ann. Natal Mus.*, i, p. 36 (*circumtexta* and *analogica*).
1910. Dautzenberg. *Act. Soc. Linn. Bordeaux*, p. 55 (*gallandiana* Fischer).
1912. id. *Ann. Inst. ocean.*, vol. V, fasc. 3, p. 33 (*trifasciata* Adams).
1923. Odhner. *Göteb. K. Vet. Handl.*, xxvi, p. 6 (*trifasciata* Adams).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 182 (*circumtexta*).
1928. Tomlin. loc. cit., p. 316 (*circumtexta*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 59 (*trifasciata* Adams).

Radula. Thiele gave the number of cusps on the central plate of a radula 4·5 mm. long as 8. In S. Afr. Mus. specimens of radulae 3·5–4·5 mm. long, there are 65–75 rows, central plate with 11–13 (rarely 10) cusps, slightly variable in size *inter se*, with a minute one externally on both sides, no intermediate plate, outer cusp of the lateral plate with a slight bulge (scarcely a denticle) on inner margin, but sometimes obscure, inner cusp rather slender. No difference in the radulae of the '*trifasciata*' and *analogica* forms.

The 1st whorl always, and usually also the 2nd whorl, appear to have only spiral lirae; but axial ribs may be developed on the 3rd and 4th whorls, or on the 4th and 5th, or on the 5th and 6th, or on all these whorls (3–6). The number of ribs is 14–15 on 3rd whorl, *c.* 20 on 5th, and 22–24 on 6th.

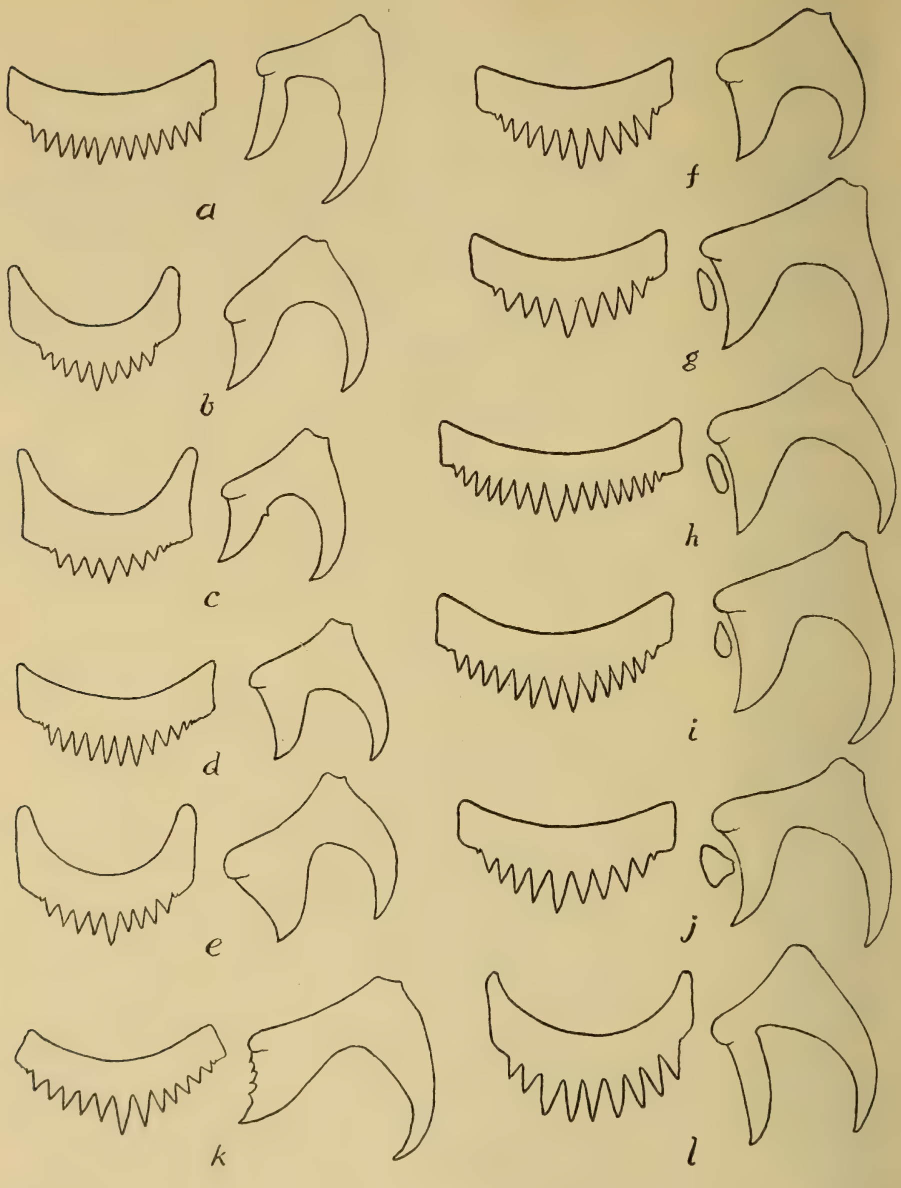


Fig. 22.

Central and lateral radula plates of *Nassa* (*a*) *analogica* Sow.; (*b*) *kochiana* (Dnkr.); (*c*) *speciosa* A. Adams; (*d*) *desmoulioides* Sow.; (*e*) *babylonica* Watson; (*f*) *eusulcata* Sow.; (*g*) *gemmulata* (Lam.); (*h*) *bicallosa* Smith; (*i*) *arcularia* Linn.; (*j*) *coronata* Brug.; (*k*) *kraussiana* (Dnkr.); (*l*) *Demoulia abbreviata* (Gmelin).

The ribs are distinctly oblique (retractive), and when present on the 6th whorl they cross the base as far as the columella glaze.

Periostracum thin, minutely fimbriate in some well-preserved specimens, pale grey or buff.

Operculum triangularly oval, margins entire.

Dead: west coast Cape Peninsula, Port Alfred; also Great Fish Bay (Angola) (Thiele).

Living (and dead): 'trifasciata' form: from off East London to False Bay and off Cape Point, 26–58 fathoms (von Martens, Sowerby, and S. Afr. Mus. P.F. coll.); '*analogica*' form: from False Bay around Cape Point to the Saldanha Bay area, 22–80 fathoms (S. Afr. Mus. P.F. coll.); St. Helena Bay, 27 metres (per U.C.T.). 26° 33′ S 15° E., 55 metres (s.s. *Africana*, per U.C.T.).

Remarks. The extreme forms: a fully plicate '*trifasciata*' and a spirally lirate *analogica*, are very different in appearance. Sowerby said (1903, p. 220) the two forms 'when separated' showed very little variation; the difficulty is to separate them!

In *analogica* the spiral lirae are always flat-topped, but their width varies according as they are separated by narrow striae or flat-bottomed grooves, which latter may sometimes be almost as wide as the lirae. The width of the spiral lirae appears to be less variable in the plicate form.

The *Pieter Faure* material in the S. Afr. Museum shows that the more or less plicate form is found on the south coast as far west as False Bay and Cape Point, but not on the west coast (a beach-worn specimen from Table Bay is an exception); the lirate form is more characteristic of the west coast, but occurs throughout the south coast area.

Both von Martens and Smith regard Adams's locality (Vigo Bay, Spain) as erroneous.

Dautzenberg (1912) regards *gallandiana* Fischer 1862 as synonymous with *triafasciata* Adams, with distribution: mouth of the Congo River, 25 metres, and (loc. cit. 1910) Lagos and Senegal. The identity of the Angolan, and especially the west African examples, with South African examples requires investigation.

Nassa pyramidalis (A. Adams)

1853. A. Adams. *Proc. Zool. Soc. Lond.* (for 1851), p. 113 (*Desmoulea p.*).
1886. Sowerby. *J. Conch.*, v, p. 4 (*Desmoulea p.*).
1900. id. *Proc. Mal. Soc.*, iv, p. 2, pl. 1, fig. 5 (*filmerae*).
1928. Tomlin. loc. cit., p. 318 (*filmerae*) and p. 325 (*pyramidalis*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 59, pl. 14, nos. 435, 436, 437 (*pyramidalis*, and vars. *affiinis* and *punctilineata*); and p. 59 (*filmerae*).
1932. id. *J. Conch.*, xix, p. 370 (*rufanensis* nom. nov. for *affinis* preocc. Sow. 1832).

Pyramidal. Protoconch 3 whorls, diam. and alt. 0·75–0·8 mm., smooth, glossy. Postnatal whorls 7; axial ribs 13–14 on 1st, increasing to 14–15, from suture to suture, straight or slightly oblique (protractive), more strongly marked on early whorls, and usually evanescent on last half of 7th whorl; crossed by

spiral lirae, 4 on 1st whorl, 5 on 2nd, 6 on 3rd and increasing to 10–11 on last whorl, 12–14 additional lirae on base and 7–8 on rostrum. On later whorls the lirae become flattened and broader than the intervening striae, and the surface of the whorls is better described as being smooth with impressed spiral striae; a very characteristic sculpture. Internal parietal callus nodular, columella smooth, anteriorly subcarinate, columella glaze not extensive, thin. Outer lip internally plicate, and end plica posteriorly and anteriorly dentiform. 22 (protoconch and first 2 whorls missing) × 13 mm.

Operculum and radula?

Cream with orange-brown irregular marks, more or less connected to form a sutural band, or with a series of dots along some of the lirae, aperture and columella more or less brownish, apex in worn specimens sometimes violaceous.

Port Elizabeth, Port Alfred, Pondoland. Mouth of Gouritz River, and Jeffreys Bay (S. Afr. Mus.). Algoa Bay, 10 fathoms, off Cape St. Blaize, 28 fathoms, off Cove Rock (East London area), 80–130 fathoms, off Umhloti River (Natal), 40 fathoms (S. Afr. Mus. P.F. coll.). 30° 47′ S. 30° 29′ E. 24 fathoms (U.C.T.).

Remarks. Only dead specimens known, though one of the Cape St. Blaize specimens, and the 6 juveniles from Umhloti, obtained by the *Pieter Faure*, were quite fresh. U.C.T. obtained one dead shell in Algoa Bay, and one dead but fresh specimen off Scottburgh, Natal.

There are 3 cotypes of *filmerae* from Pondoland (don. Dr. H. Becker) in S. Afr. Museum; it seems strange that Tomlin did not definitely unite this with *pyramidalis*.

Nassa babylonica Watson

Figs. 22(*e*), 23(*e*)

1882. Watson. *J. Linn. Soc. Lond.*, xvi, p. 366.
1886. id. *Challenger Rep.*, xv, p. 185, pl. xi, fig. 8 (with protoconch and operculum).
1899. Smith. *Ann. Mag. Nat. Hist.* (7), iv, p. 243 (*diluta*).
1901. *Illustr. Zool. Investigator. Moll.*, pl. xi, figs. 3, 3*a* (*diluta*).
1901. Melvill & Standen. *Proc. Zool. Soc. Lond.*, ii, p. 409.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 100, pl. 3, figs. 7, 8.
1903. Thiele. ibid., p. 167, pl. 9 (4), fig. 53 (radula).
1925. id. ibid., xvii, p. 183.
1928. Tomlin. loc. cit., p. 314.

Turreted, with square shoulders. Protoconch $3\frac{1}{4}$–$3\frac{1}{2}$ whorls, diam. and alt. 1 mm., smooth, the 3rd whorl carinate below middle of whorl, the carina descending into the suture on last quarter whorl. Postnatal whorls 5; axial ribs 11–12 on 1st whorl, increasing to 14–15 on last whorl, sharply tubercular at top, slightly indented immediately below; spiral lirae feeble, 3–4 traceable on lower part of 4th and 5th whorl, with 3–4 stronger additional ones on base. Outer lip feebly denticulate within. 0·45 × 0·23 in. (Watson); 10 × 5 mm. (S. Afr. Mus.); 12 × 7 mm. (Smith: *diluta*).

Operculum triangularly oval (more triangular than in Watson's figure), not quite twice as long as broad, margins entire.

Radula with 60–65 rows, central plate strongly concave in front, with 8–9 (10) cusps, slightly varying in size *inter se*, the middle one usually the largest, the outermost one or two on either side minute, lateral plate with rather short cusps, the inner one stout, no intermediate plate.

Off Cape Natal (Durban), 400 fathoms, 24 specimens, most of them dead (S. Afr. Mus. P.F. coll.).

Distribution. East Africa. 1,134–1,644 metres (von Martens); Gulf of Oman and Karachi, 37–80 fathoms (Melvill and Standen); off Ceylon, 597 and 753 fathoms (Smith); Philippine Islands, 375 fathoms (Watson).

Remarks. Von Martens illustrated plump and slender forms. In the present lot there are two broken specimens with 4 whorls measuring 10 × 5·5–5·75 mm.

Smith's *diluta* has one or two fewer ribs, but can scarcely be regarded as distinct.

Only one specimen was available for Tomlin's inspection; the other examples have since been found in a bottom sample from the same locality.

For comparison of protoconch with that of *bicallosa*, see latter p. 108.

Nassa capensis (Dnkr.)

Fig. 23(*a*)

1880. Von Martens. *Mauritius & Seychellen*, p. 243.
1928. Tomlin. loc. cit., p. 315 (references and synonymy).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 55, pl. 12, no. 412 (*kraussi*).
1932. id. ibid., p. 58, pl. 13, no. 425 (*ordinaria*).

Protoconch $2\frac{1}{2}$ whorls, diam 0·6, alt. 0·75 mm., smooth. Postnatal whorls 7; axial ribs (9) 10 on 1st whorl, 10–11 on 2nd, 11–12 on 3rd, 12–13 (14) on last whorl, suture to suture, oblique, protractive, evanescent on base; crossed by spiral lirae 4 (5) on 2nd–4th whorls, obscure on 1st and usually not continued on to 5th, always obsolete on 6th and 7th leaving the ribs and intervals perfectly smooth; 2 rather broad flat spiral lirae on base anteriorly and 6 striae on rostrum. Internal parietal callus cariniform, columella smooth, carinate at anterior end, columella glaze not extensive, thin. Outer lip with varix in adult, internally plicate (but often feebly). 16·5 × 6 mm.

Operculum and radula?

Cream or buff, speckled or dappled, with a more or less marked brown band on lower part of base, bordered above by a disconnected series of dashes (one in each interval between the ribs) which appears just above suture in preceding whorls; in juveniles protoconch and 1st whorl brown, following whorls glistening white; sometimes pure white (but ? faded), or unicolorous yellowish, amber, ochraceous or brown (*serotina*); anterior canal often rusty brown.

False Bay to East London and Natal (Tomlin, S. Afr. Mus.); also (small form) Tongaat (Natal).

Distribution. Mauritius and Réunion (von Martens).

Remarks. Plump and slender forms occur, e.g.: 10 × 5 mm. and 10 × 4 mm. The ribs on successive whorls are more or less in an axial line, sometimes very distinctly so (resembling a *Scalaria*).

Protoconchs and juveniles were collected at Still Bay by the late Dr. Muir.

It is remarkable that no living specimens have been collected.

The Mauritius and Réunion records should be checked, also Bisacchi's (1930) record of *pulchella* from Suez.

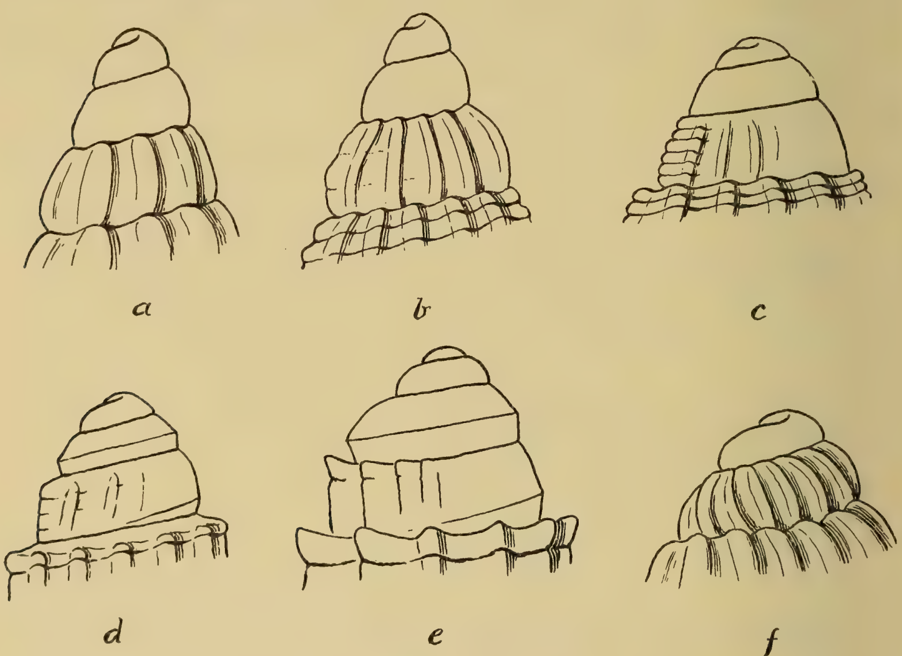


Fig. 23.

Protoconchs of *Nassa* (*a*) *capensis* (Dnkr.); (*b*) *kochiana* (Dnkr.); (*c*) *desmoulioides* Sow.; (*d*) *bicallosa* Smith; (*e*) *babylonica* Watson; (*f*) *kraussiana* (Dnkr.).

Nassa kochiana (Dnkr.)

Figs. 22(*b*), 23(*b*)

1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 28 (*crawfordi*).
1925. Thiele. ibid., xvii, p. 182 (*limata* Chemn.).
1928. Tomlin. loc. cit., p. 319 (references and synonymy) and p. 327.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 56, pl. 13, no. 417 (*eucosmia*), and p. 57, pl. 13, no. 419 (*carinata*).

Protoconch 2½ whorls, diam. 0·6, alt. 0·75 mm., smooth. Postnatal whorls, 7; axial ribs 12–13 on 1st whorl, 13–14 on 2nd, 14–15 on 3rd, increasing to 15 or 16 to 18 on last whorl, from suture to suture, slightly curved and

protractive, continued across base; crossed by spiral lirae 4 on 1st whorl, 5 (6) on 2nd, 6 (7) on 3rd, increasing to 13–14 on last whorl, 2 or 3 of the lirae on early whorls and 4 or 5 on the later whorls near the suture are fine and narrower than the others; 5 (6) additional lirae on base, sometimes with finer intermediaries, 6 striae on rostrum. Internal parietal callus cariniform, columella smooth but sometimes feebly granulate, carinate at anterior end, columellar glaze not extensive, thin. Outer lip with varix in adult, internally plicate. 14 × 6 mm.

Operculum oval, margins entire.

Cream or buff with faint dappling or spiral lines, chiefly on base, with a series of brown spots forming a broken narrow spiral band just below periphery from upper end of aperture on last whorl, on earlier whorls just above suture, sometimes with a white band above the dark band (*spurca* and *poecilostoma*); or unicolorous yellowish, ochraceous, brown, or pinkish (*coccinea*); in juveniles protoconch and early whorls glassy white with indications (on 2nd and 3rd whorl) of dappling and the brown spiral line; anterior canal often rusty brown; or with 9–10 pale brown narrow spiral bands on last whorl (incl. base), the ends of which appear on the outer lip varix as double lines (*crawfordi*).

Radula with *c.* 60 rows, central plate strongly concave in front, with 9 cusps and a minute one externally on either side, inner cusp of lateral plate moderately stout, no intermediate plate.

Fossil: raised beach Algoa Bay.

False Bay to Port Alfred. The only record from the west coast (Tryon: Table Bay) is scarcely acceptable.

Living: False Bay, 24 metres (U.C.T.).

Remarks. Thiele (1925) disagreed with von Martens's (1903) identification of shells from St. Francis Bay as *crawfordi*, preferring to identify them with *limata* Chemn. (Mediterranean, Madeira, Canaries, Cape Verde Is., and West Africa); von Martens is more likely to have been correct.

Dautzenberg (1912, *Ann. Inst. ocean.*, vol. 5, fasc. 3, p. 31) recorded *poecilostoma* Smith from Mossamedes, littoral and 15–20 metres. I think these specimens should be re-examined.

The obliquity of the ribs varies, and may vary from whorl to whorl on the same shell. Also there are plump and slender forms.

Comparison of *kochiana* with European *incrassata* at once shows the differences: in the latter the axial ribs are retractive, the number of spiral lirae on the 6th whorl is only 6, the intersections are more nodulose, the profile is undulate (notched in *kochiana*), and there are no fine lirae below the suture, or at most only one and that one is only very slightly narrower than the following lirae.

Nassa muiri n. sp.

1932. Turton. *Mar. Sh. Pt. Alfred*, p. 58, pl. 13, no. 428 (*microstoma*, non Pease) and no. 429 (*ambigua*, non Mont.).

Protoconch $2\frac{1}{2}$ whorls, diam. 1–1·25, alt. 0·75–0·8 mm., smooth. Postnatal whorls 4, profile rather strongly convex; axial ribs 15 on 1st whorl, 18–19 on 2nd, 21–23 on 3rd and 4th, but often obscure on 4th and only *c.* 17–18 countable, sometimes only 17 on 2nd and 3rd, and 18 on 4th whorl, straight (or nearly so) and retractive; crossed by spiral lirae 6 on 1st whorl, 7 on 2nd, 8 on 3rd, 9–10 on 4th, intersections here and there irregularly nodulose, 7–8 additional lirae on base, 4–5 striae on rostrum. Columella smooth, angulate anteriorly, columellar glaze not extensive; parietal callus feeble; outer lip with varix, internally more or less plicate. 10 × 6·5 mm. (Turton gave '*c.* 16 mm.' for *microstoma*, but the line alongside the figure is only 11 mm.)

Operculum oval, margins entire.

Pale buff, with irregular orange-brown marks giving an impression of more or less distinct flames, chiefly around upper half of whorl, which may thus be nearly uniformly brown; two or three marks on outer lip varix; anterior canal orange-brown.

Radula with 60–65 rows, central plate strongly concave in front, 8–9 (10) cusps, with a small or minute one externally on either side, inner cusp of lateral plate moderately stout, no intermediate plate.

Port Alfred (Turton, also S. Afr. Mus. one example from Turton labelled '*quantula*'); a series from possibly the same locality (S. Afr. Mus.); Still Bay, juvenile (protoconch plus 2 whorls), very fresh (S. Afr. Mus. Muir coll.); from stomach of seal caught in False Bay, seven examples (S. Afr. Mus.); Algoa Bay, 52 fathoms, and off East London, 32 fathoms (S. Afr. Mus. P.F. coll.); False Bay (34° 18′ S. 18° 29′ E.), 51 metres (U.C.T.); 34° 15′ S. 25° 5′ E. 6 fathoms, and 33° S. 28° 11′ E. (off East London), 31 fathoms (U.C.T.).

Remarks. Turton's photographic figures of what he recorded as possibly *microstoma* and *ambigua*, certainly represent this species. Mr. Salisbury informs me that it is not the West Indian *ambigua*.

The straight and slightly retractive axial ribs distinguish it from *kochiana*.

Named after the late Dr. John Muir, of Riversdale.

I am diffident about introducing another species so close to *plebeja* Thiele, but the shells can be distinguished at a glance by the more numerous spiral lirae in *muiri*. The sulci are consequently narrower than the lirae, which produces a lirate sculpture; whereas in *plebeja* the lirae and sulci are subequal, producing a more cancellate sculpture.

Nassa plebeja Thiele

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 182, pl. 32 (20), fig. 9.

Protoconch $2\frac{1}{2}$ whorls, diam. 0·75, alt. 0·6 mm., smooth. Postnatal whorls $4\frac{1}{2}$; axial ribs 14 on 1st whorl, increasing to 15 (16 incl. varix) on last whorl, straight or slightly curved, slightly retractive, obsolete on base of body whorl; crossed by spiral lirae 4 on 1st-3rd whorls, 5 on 4th, on 3rd and 4th

whorls an additional finer lira appears between the suture and the uppermost lira, 4 additional rather sharp lirae on base and 5–6 on rostrum; intersections with ribs slightly nodulose. Columella angulate anteriorly, columellar glaze narrow; parietal callus feeble (distinct in Thiele's figure); outer lip with varix, plicate within. 7 × 4 mm. Thiele: 6·25 × 3·5 mm.

Uniform greyish. Brown above and below the periphery, anterior canal darker (Thiele).

St. Francis Bay, 80 metres, and Algoa Bay (Thiele). Algoa Bay 51 fathoms, two dead (S. Afr. Mus. P.F. coll.). False Bay (U.C.T.).

Distribution. Great Fish Bay, Angola (Thiele).

Remarks. The single U.C.T. specimen and the two P.F. specimens appear to agree with *plebeja*, assuming that Thiele's figure is correct; his description does not give the number of axial ribs or spiral lirae.

The identity of the Angolan specimens is provisionally accepted. cf. Odhner's record of *ambigua* Mont. from Port Alexander (1923. *Goteb. K. Vet. Handl.*, xxvi, 7, p. 14).

Nassa bicallosa Smith

Figs. 22(*h*), 23(*d*)

1876. Smith. *J. Linn. Soc. Lond.*, xii, p. 543, pl. 30, fig. 1.
1928. Tomlin. loc. cit., p. 313 (*algida*, non Rve., part: S. Afr. Mus. no. A6398).
1928. id. ibid., p. 314.

Protoconch 3½ whorls, diam. 1, alt. 0·75–0·8 mm., smooth, a faint peripheral keel on last whorl and half. Postnatal whorls 6 (7 in two specimens); profile of whorls straight or nearly so, squarely shouldered at top; axial ribs 13–14 on early whorls, increasing to 15–16 or 17 on later whorls, where some of them are often more or less duplicated, from suture to suture and distinctly oblique (retractive) from 1st to 5th whorls, on later part of 5th and on 6th becoming evanescent except as knobs at top of whorl, sometimes strongly, sometimes feebly developed; one spiral stria marking off the coronal knobs on all whorls, but evanescent on last whorl, 6–7 striae on lower part of base and 3–4 on rostrum. External parietal callus opposing tooth on outer lip nodular (in adult), labral sinus deep, internal callus dentiform or subcarinate; columella anteriorly carinate and denticulate, glaze not extending over base, its edge free. Outer lip internally plicate. 26 × 15 mm. (6 whorls), 27 × 15 mm. (7 whorls).

Operculum triangularly ovate, serrate on both margins (when not corroded), 7–8 × 5 mm.

Living examples from 24 fathoms varying from buff, slightly stained with orange, to reddish-brown, partly coated with some black substance, aperture brownish within, outer lip white, operculum amber or dark brown.

Specimens from 14 fathoms varying from reddish or chestnut brown to almost black, most specimens more or less corroded and covered with some

(? algal) substance, chiefly on the upper side while the lower side remains polished.

Radula with *c.* 75 rows, central plate with 16 cusps, outermost one or two on either side minute, intermediate plate oval, lateral plate without denticles between the 2 cusps.

Cape Natal (Durban) (Smith). Off Tongaat, 36 fathoms, one juv. dead, and off Umhlanga, 22-26 fathoms one juv. dead; off Umkomaas, 40 fathoms, 3 protoconchs (S. Afr. Mus. P.F. coll.).

Living: off Tugela River, 12–14 and 24 fathoms (Tomlin, S. Afr. Mus. P.F. coll.).

Remarks. Tomlin, by a slip, referred some of the specimens (S. Afr. Mus. no. A6398) dredged in 12–14 fathoms to '*algida*'; they are clearly the same as those dredged in 24 fathoms (A6399).

The specimens from the deeper water are not corroded and are quite clean except for traces of foreign matter on the upper whorls; they are also more strongly coronate than most of the shallower water examples. The operculum of the latter is also more or less corroded to an irregular oval shape.

The double columella callus may serve to distinguish this species from *glans-suturalis*, but is found in other species e.g. *coronata.*

The three very juvenile examples, consisting of protoconch and first two postnatal whorls, one of them quite fresh and translucent, show that the species is living as far south as Umkomaas.

Apart from the 1st and 2nd postnatal whorls, the protoconch would be indistinguishable from that of *babylonica*; the straight-sided early whorls are very similar in the two species, but *bicallosa* has one or two more ribs, and the tops of the ribs are not so mucronate as in *babylonica.* The profile of the later whorls becomes gradually oblique in *bicallosa*, producing a pyramidal shell, whereas in *babylonica* it remains essentially vertical, and the adult shell is turreted.

Nassa glans (Linn.)

1758. Linne. *Syst. Nat.*, 10th ed., p. 737, sp. 394 (*Buccinum g.*).
1822. Lamarck. *Anim. sans. Vert.*, vii, p. 269 (*Buccinum suturale*).
1859. Chenu. *Man. Conch.*, i, fig. 771.
1880. Von Martens. *Mauritius & Seychellen*, p. 242 (*suturalis*).
1886. Watson. *Challenger Rep.*, xv, p. 179 (references).
? 1901. Smith. *J. Conch.*, x, p. 111, pl. 1, fig. 17 (*algida*, non Rve.).
1928. Tomlin. loc. cit., p. 313 (*algida*, non Rve., part: S. Afr. Mus. no. 14039).
1928. id. ibid., p. 325 (*suturalis*).
1952. Satyamurti. *Bull. Madras Govt. Mus.*, n.s. I, ii, 6, p. 184, pl. 17, figs. 7 *a*, *b* (*suturalis*).
1956. Day & Morgans. *Ann. Natal Mus.*, xiii, p. 306 (listed, as *algidus*, non Rve.).

Protoconch 1½ (2) whorls, smooth. Postnatal whorls 6; axial ribs *c.* 18–22 on early whorls, from suture to suture, but evanescent on 6th whorl except as a series of coronal nodules; crossed by 3 spiral striae dividing the ribs into 4 approximately equal-sized nodules, evanescent as impressed striae on 5th

whorl, but often indicated by thin coloured lines, a 4th stria partly visible in the suture; 4 additional lines on base, the lower 2 of which are again impressed striae, 6–8 striae on rostrum. Internal parietal callus strongly cariniform, columella carinate at anterior end, glaze not extensive, edge free on rostrum. Outer lip thin, with strong tooth posteriorly opposite the parietal callus, forming a deep sinus, internally non-plicate. 25 × 13 mm. (S. Afr. Mus.); 31 × 18 mm. (Smith).

Operculum triangularly ovate, serrate on both margins, 3 × 2·5 mm. in aperture 10 mm. in shell 20 mm. long.

Yellowish with diffuse orange blotches or flames, early whorls pinkish, protoconch crimson, the spiral striae and lines orange-brown (dead specimens).

Animal pale, spotted with black on siphon and proboscis, tentacles pale.

Radula with *c.* 70 rows, central plate with 10 cusps, intermediate plate oval, lateral plate without denticles between the cusps.

Durban (Smith, Tomlin, S. Afr. Mus.).

Distribution. Zanzibar (S. Afr. Mus.), Mauritius, Ile de France, Indo-Pacific.

Remarks. N. suturalis is regarded as a small variety of *glans* (Watson, loc. cit.).

One of the shells described above was identified many years ago by J. H. Ponsonby, who doubted its South African provenance; later Tomlin confirmed the identity of this shell. Tomlin also identified 4 shells from Durban (S. Afr. Mus. no. 14039) as *algida* Rve. I cannot agree because the sculpture of the early whorls is the same as in the shell labelled *suturalis*, and the coloration is similar except that the orange-brown spiral lines are faded or worn away. I suggest also that Smith's identification was erroneous, and that the Australian *algida* be deleted from the South African fauna-list.

S. Afr. Museum has 2 examples of *glans* from the Philippines (ex Ross-Frames coll.): 7 whorls 44 × 23 mm., and 6 whorls 39 × 21 mm. Also 2 from Zanzibar (E. L. Layard, H.M.S. *Castor*, coll. 1856); 6 whorls 30 × 16 mm. and 5 whorls 21 × 11 mm. In these the 4th spiral line is visible throughout, nowhere covered by the suture; otherwise there is no difference, except the large examples are feebly plicate within the aperture.

Nassa coronata Brug.

Fig. 22(*j*)

1789. Bruguière. *Encycl. Meth. Vers,* 1, p. 276 (*Buccinum c.*).
1880. Von Martens. *Mauritius & Seychellen,* p. 242.
1928. Tomlin. loc. cit., pp. 317 and 327.

Protoconch 1½ whorls, smooth. Postnatal whorls 6; axial ribs 20–21 on 1st whorl, 22–23 on 2nd, 23–24 on 3rd, then decreasing to 18 on 4th, 10–12 on 5th and 6th whorls, suture to suture and straight or very slightly oblique (retractive) on 1st to 4th whorls, on 5th and 6th evanescent except as rounded

nodules forming a coronal shoulder; crossed by 3 spiral striae, one above and 2 below, the 2nd and 3rd closer together than the 1st and 2nd, demarcating 3 series of nodules, rounded in the uppermost series, axially elongate oblongs in the middle series and squarish areas in the third series; spirals continued on to 5th whorl but thereafter obsolete; 3 striae on lower part of base, 3–4 on rostrum. External parietal callus nodular, internal callus dentiform or subcarinate, labral sinus deep; columella subcarinate anteriorly and with 2–3 feeble plicae, glaze extensive, thickened in adult. Outer lip internally plicate. 32 × 20 mm.

Operculum subtriangular, 5–8 serrations on both margins, 6 × 6 mm. in 28 mm. shell.

Grey or bluish-grey, with cream coloured coronal knobs and a spiral band in middle of whorl, a narrower band lower down on base; outer lip externally and internally, and columella glaze white, aperture within brownish with the external pale bands showing through.

Radula with 65–75 rows, central plate with 10–12 cusps, intermediate plate piriform, lateral plate without denticles between the 2 cusps.

Fossil: raised beach, 375 ft. alt., Durban-Umgeni (Geol. Surv.).

Natal (Krauss, Tomlin, S. Afr. Mus.).

Living: Delagoa Bay (U.W.); Inhambane (U.C.T.).

Distribution. Mauritius, Madagascar, Aden, Indo-Pacific.

Nassa margaritifer (Dnkr.)

1928. Tomlin. loc. cit., p. 321.

Protoconch 1½ (2) whorls, smooth. Postnatal whorls 7; axial aribs 17–18 on 1st whorl, increasing to 24–26 on last, from suture to suture, straight, slightly oblique (retractive); crossed by one open groove on 1st whorl, 2 on 2nd and 3rd, and 3 on 4th–6th whorls, with a feebler 4th groove on later part of 6th and on 7th whorl, dividing the ribs into 3 series of rounded nodules, 4 series on 6th and 7th whorls; the uppermost groove below the subsutural nodules conspicuously wider than the other grooves; ribs on base extending to columella glaze and divided by 7 grooves into nodules. External parietal callus bulbous but not prominent, internal callus strongly cariniform, columella nodulose, carinate anteriorly, glaze not extensive but rather thick, edge on rostrum free. Outer lip feebly toothed posteriorly, internally plicate, externally thickened, more or less varicoid. 27 × 14 mm.

Operculum triangularly oval, margins undulate (probably serrate when fresh), 7 × 4 mm. in 26 mm. shell.

White with greyish shading and slaty-grey or purplish-brown irregular blotches and markings, a more or less continuous band of same colour around middle of last whorl (concealed by suture in earlier whorls), and another less well-marked below suture, columella and outer lip white, aperture within with

1–3 (usually 3) purplish bands, the one corresponding with the external peripheral band always present.

Dead: Durban (Smith); Bartholomew Diaz, Bazarute Islands, Portuguese East Africa (S. Afr. Mus. coll. Ross-Frames).

Distribution. Red Sea, Ceylon, Indo-Pacific.

Remarks. The Ross-Frames specimens were probably taken alive, though none of them now possess opercula.

A worn specimen in S. Afr. Mus. (no. 2623) registered as from Durban, was identified by Tomlin as the European *reticulata* Linn. 'doubtless from ballast'. It has a sutural and a peripheral dark band, and is so similar to *margaritifer* that the following differences between the two species may be given in case more 'ballast' specimens come to hand.

In fresh *reticulatus* (British specimens) there are only 12 axial ribs on 1st whorl, increasing to 20 on 7th; on last whorl there are 5 spiral sulci dividing each rib into 5 nodules, 7 additional sulci on base; the uppermost sulcus is an open groove (as in *margaritifer*) but the 1st nodule below the suture is double; a small nodule separated by a narrow impressed line from the larger (main) nodule; all the nodules are flat above, sloping below, so that the profile of the whorl is stepped or feebly serrate (in *margaritifer* it is only undulate). No external parietal callus and internal callus very feeble, columella nodulose only at anterior end, glaze more extensive. All these features are traceable in the 'ballast' specimen and confirm Tomlin's identification.

Braga (1952) has recorded *albescens* Dnkr. from Mozambique, and Thiele (1925) described *incognita* from Dar-es-Salaam, both of which might usefully be compared with the present species.

Nassa fenestrata Marrat

1848. Krauss. *Südafr. Moll.*, p. 122 (*Buccinum marginulatum*, non Lam.).
1877. Marrat. *New Forms of Nassa*, p. 10.
1928. Tomlin. loc. cit., p. 317, also p. 321 (*marginulatus*).
1931. id. *J. Conch.*, xix, p. 107.

Protoconch 1½ (2) whorls, smooth. Postnatal whorls 5; axial ribs 24 on 1st whorl, increasing to 26 on 5th, from suture to suture, straight but slightly oblique (retractive) on later whorls; crossed by 3 spiral striae on 3rd whorl, dividing the ribs into 4 nodules, on 4th whorl upper (sutural) nodules divided by an additional stria, and 2 striae between 1st (sutural) and 2nd series of nodules, producing a narrow lira between the two series; on 5th whorl a 2nd stria dividing upper nodules into 3, and the narrow lira is repeated between each pair of nodules, thus broad and narrow nodules alternating; on base 7 additional series of nodules (or broad lirae) alternating with narrow lirae. Internal parietal callus cariniform, columella nodulose anteriorly, glaze strong, thick and somewhat bulbous. Outer lip reflexed, thickened, glazed, internally plicate. 20 × 11·5 mm., and plump form 18 × 12 mm.

Operculum and radula?

Cream or buff or greyish, 3 indistinct darker greyish bands: one subsutural, one peripheral, and one at bottom of base; columella glaze and outer lip white, aperture internally with 3 more or less distinct brownish bands.

Dead: Mozambique (Marrat); Durban (Krauss, Sowerby, Tomlin, S. Afr. Mus.).

Living: Inhambane (S. Afr. Mus.); Delagoa Bay (U.W.).

Distribution. Mauritius (S. Afr. Mus.); Red Sea; Philippines and Australia (Marrat).

Remarks. The Inhambane specimens were evidently taken alive because the animals have been eaten out by Anthrenus (larval skins remaining in aperture), but the opercula have been lost.

N. martensi Thiele 1925 from Dar-es-Salaam, should be compared with this species.

Nassa eusulcata Sow.

Fig. 22(*f*)

1902. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 94, pl. 2, fig. 8.
1928. Tomlin. loc. cit., p. 317.

Protoconch 2 (2½) whorls, smooth. Postnatal whorls 7; axial ribs 13–14 on 1st whorl, increasing to 18 on last, but often on back of outer lip additional ribs crowded together to a total of 20–26, from suture to suture, slightly oblique (retractive); crossed by 3 spiral striae on 1st–4th whorl, 4 on 5th, 5 on 6th, and 6 on 7th whorl, the uppermost stria however from 4th whorl onwards becoming a well-marked sulcus separating the tops of the ribs as a subsutural series of nodules; on base 7 (8) striae become stronger and more open sulci anteriorly, with rather sharp intervening lirae, the intersections slightly nodular. Internal parietal callus cariniform, followed by columella nodules, glaze narrow, not spreading over base. Outer lip plicate within. 19 × 10 mm.

Operculum broadly oval, 3 strong serrations on outer, 2 on inner margin, 4 × 3 mm. in 17 mm. shell.

Radula with 60–65 rows, central plate with 10 cusps (12 in one of three specimens), outermost on either side minute, no intermediate plate, lateral plate without denticles between the 2 cusps.

Living (and dead): off Tugela River, and off O'Neil Peak (Zululand), 40–55 fathoms (Sowerby, Tomlin, S. Afr. Mus. P.F. coll.).

Nassa natalensis Smith

1903. Smith. *Proc. Mal. Soc.*, v, p. 373, pl. 15, fig. 6.
1928. Tomlin. loc. cit., p. 322.
1936. Peile. *Proc. Mal. Soc.*, xxii, p. 140 (radula).

Protoconch ? Postnatal whorls 6, profile angular in middle of whorl; axial ribs 12 on 2nd whorl, 12–13 on later whorls, strong on early whorls, less

so on last whorl, nodular at top below suture and at periphery, continued over base where they are also nodulous; 6 lirae on base, obscure above, stronger below. External parietal callus strong, bulbous, internal callus cariniform, columella smooth, carinate anteriorly, glaze rather broad but not extending over base, edge free on rostrum. Outer lip thickened, with varix, internally plicate. 20 × 12·5 mm. (Smith's figure: 21 mm.)

Operculum ?

Cream or greyish, on body whorl a series of horizontally oblong dark brown streaks between the ribs, forming a narrow broken band from posterior end of aperture, mostly concealed by suture in earlier whorls (Smith's figure shows the dark band crossing the ribs as well as the intervals); Smith mentioned one specimen as being 'a rich brown colour with a white line above the middle of the body whorl'.

Radula (Peile) lateral plate with denticles between the 2 cusps, inner edge of the inner cusp sometimes serrulate, ? intermediate plate (not mentioned).

Natal (Reeve, Smith, S. Afr. Mus.); Mozambique Island (U.W.).

Nassa arcularia Linn.

Fig. 22(*i*)

1852. A. Adams. *Proc. Zool. Soc. Lond.* (for 1851), p. 98 (*sulcifera* = monstrosity).
1880. Von Martens. *Mauritius & Seychellen*, p. 242 (incl. *rumphii* Desh. and *pullus* Lam.).
1928. Tomlin. loc. cit., p. 314, p. 324 (*pullus*), and p. 327.
1930. Bisacchi. *Ann. Mus. Civ. Genoa*, lv, p. 44, and p. 47, figs. 1–3 (*pullus*).
1933. Krige. *Tr. Geol. Soc. S. Afr.*, xxxv (1932), p. 52.
1938. Adams & Leloup. *Mem. Mus. Roy. H. N. Belg.*, Hors Série II, 19, p. 183, pl. 8, fig. 7 *a*, *b* (juv.).
1942. Gravely. *Bull. Madras Govt. Mus.*, n.s. V, no. 2, p. 60 (in key), fig. 11 *e*. (*pulla*).
1952. Braga. *Anais Est. Zool. Ultramar*, vii, 3, p. 74, pl. 3, fig. 2.

Protoconch $1\frac{1}{2}$ whorls, smooth. Postnatal whorls 5; axial ribs 19–20 on 1st and 2nd whorls, 16–17 on 3rd, 15 on 4th, 13–15 on 5th, suture to suture, slightly oblique (retractive), continued on base except on last portion of 5th whorl where there are 4–6 oblique costae followed by the labral varix; crossed by 3 spiral striae, equidistant, the uppermost a little distance below the coronal knobs, 5–6 striae on base and 3 on rostrum in juv., tending in adult to become open grooves. Parietal callus in adult nodular, columella concave, anteriorly crenulate and subcarinate, glaze in adult extending over nearly half the last whorl, thickened and forming a flat polished 'sole', edge free and varicoid. Outer lip thickened in adult, internally plicate. 25 × 19 mm., and 27 × 19 mm.

Operculum broadly subtriangular, broader than long, serrate on both margins, 5 × 6 mm. in 23 mm. shell.

Yellowish-grey, outer lip and columella glaze white, aperture within brownish or violaceous with a pale spiral band which is not visible externally except faintly in juveniles.

Radula with *c.* 65 rows, central plate with 16 cusps, outermost one on either side minute, intermediate plate oval, lateral plate without denticles between the 2 cusps.

Fossil, Pleistocene: Durban (Krige, Tomlin).

Dead: Port Elizabeth (Sowerby).

Living: Natal (Krauss); Durban, Delagoa Bay, Mozambique Island (S. Afr. Mus.). Inhambane, Portuguese East Africa (U.C.T.).

Distribution. Mauritius, Réunion, Seychelles, Madagascar, Red Sea, Aden, Indo-Pacific.

Nassa gemmulata (Lam.)

Fig. 22(*g*)

1816. Lamarck. *Tabl. Encycl.*, Livr. iv, pl. 394, figs. 5 *a*, *b*, and Liste, p. 1 (*Nassa clathrata*, n. et f. only). (Not Livr. iii, 1827, as given in Tomlin.)
1822. id. *Anim. sans. Vert.*, vii, p. 271 (*Buccinum g.*).
1859. Chenu. *Man. Conchyl.*, i, fig. 765.
1886. Watson. *Challenger Rep.*, xv, p. 176.
1901. Melvill & Standen. *Proc. Zool. Soc. Lond.*, ii, p. 412.
1928. Tomlin. loc. cit., p. 318.

Protoconch ? Postnatal whorls 7; axial ribs 14 on 1st whorl, 15 on 2nd, 17 on 3rd, 22 on 4th, 28 on 5th, 24 on 6th, and 20 on last whorl, suture to suture, straight, oblique (retractive), continued across base; crossed by 3 spiral sulci on 1st–3rd whorls, 4 on 4th–6th, and 5 on later part of 6th and on 7th whorl, sulci narrow and deep especially on later whorls, dividing the ribs into rounded nodules, the uppermost forming a coronet over the sunken suture; 3 additional sulci on base, and a deep groove separating lowermost nodules from the reflexed rostrum, which has 4–5 striae. Internal parietal callus nodiform, columella more or less granulose, glaze extending over half base, edge free on rostrum. Outer lip internally plicate. 28 × 13·5 mm.

Operculum broader than long, serrate on both margins, 4 × 6 mm. in 28 mm. shell.

Buff with orange or brown irregular suffusions, aperture and glaze white.

Radula with 70 rows, central plate with 9 cusps, intermediate plate oval, lateral plate with rather stout inner cusp, no denticles between the 2 cusps.

Durban (Smith, ? dead).

Living: Inhambane, Portuguese East Africa (U.C.T.).

Distribution. Red Sea, Persian Gulf, Karachi, Indo-Pacific to Japan.

Nassa plicatella A. Ad.

1852. A. Adams. *Proc. Zool. Soc. Lond.* (for 1851), p. 111.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 9.
1912. Dautzenberg. *Ann. Inst. ocean.*, vol. 5, fasc. 3, p. 32.
1923. Odhner. *Göteb. K. Vet. Handl.*, xxvi, 7, p. 14.
1928. Tomlin. loc. cit., pp. 323 and 327.
1931. Lamy. *Bull. Mus. Paris*, (2) III, p. 304.
1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), pp. 34, 46.

Protoconch 1½ (2) whorls, diam. 1, alt. 0·6 mm., smooth. Postnatal whorls 5, profile evenly convex; axial ribs on 1st whorl 12 or 13 (junction with protoconch indistinct), 13 on 2nd whorl, increasing to 17–18 on 4th and to 20–24 on 5th whorl, suture to suture, slightly oblique (retractive), extending to base, sometimes duplicated and irregular or obscure on last half whorl; crossed by spiral lirae 5–6 on 2nd, increasing to 8–9 on 5th whorl, intersections slightly nodulose, 7–8 additional lirae on base, one (? more) on rostrum. No parietal callus, columella smooth, rather conspicuously carinate anteriorly, glaze narrow. Outer lip not toothed at either end, internally feebly plicate if at all. 27 (protoconch missing) × 15 mm.

Operculum triangularly oval, serrate on both margins.

Cream or greyish, darker in the intervals between the ribs when wet, uniform when dry.

Radula with 70–75 rows, central plate with 10 cusps, the outermost on either side minute, no intermediate plate, lateral plate without denticles between the 2 cusps.

Fossil (late Tertiary): Saldanha Bay (Tomlin, Haughton).

Dead: Walfish ('Wallwich') Bay (Adams, Lamy); Great Fish Bay, Angola (von Martens); Angra Pequena (Lüderitzbucht) (von Martens); Table Bay (Tomlin, S. Afr. Mus.).

Living: Mossamedes and Praya Amelia, littoral and 15–35 metres (Dautzenberg); Port Alexander (Odhner); Langebaan, Saldanha Bay, low tide (U.C.T.).

Remarks. Sowerby's record from Natal is not acceptable.

The number of ribs varies somewhat: in one specimen there are ?12 on 1st whorl (worn), 13 on 2nd, 12 on 3rd, 12 on 4th and 13 on 5th whorl, the intervals consequently being noticeably wider than normal. The Saldanha Bay examples are transitional.

Odhner (1923. *Goteb. K. Vet. Handl.*, xxvi, 7, p. 14, pl. 1, figs. 6, 7) described *angolensis* similar to *plicatella* but smaller, 14·2 × 7·6 mm., also from Port Alexander, 16 fathoms.

Nassa desmoulioides Sow.

Figs. 22(*d*), 23(*c*)

1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 219, pl. 4, fig. 1.
1928. Tomlin. loc. cit., p. 317.
1956. Knudsen. *Atlantide Rep.*, 4, p. 49, pl. 2, fig. 3 (laps. cal. *desmouleoides*).
1957. Franca. *Anais J. Invest. Ultramar.*, x, 2, p. 29, pl. 1, figs. 1, 2, pl. 2 (laps. cal. *desmouleoides*).

Protoconch 2 (2½) whorls, diam. 1–1·25, alt. 0·75–0·8 mm., smooth. Postnatal whorls 6, profile rounded but with squarish shoulder at the level of the sunken suture; axial ribs 16–17 on 1st whorl, increasing to 23–25 on 5th and 30–32 on 6th whorl, suture to suture, straight, narrower than intervals, sometimes on later part of 6th whorl becoming irregular or even obsolete;

crossed by spiral lirae 7 on 1st and 2nd whorls, 8 on 3rd, increasing to 10–11 on 6th, intersections more or less nodular, especially on upper part of whorls; 7–8 additional lirae on base and 3–4 on rostrum. Parietal callus subcariniform, columella concave, feebly crenulate and carinate anteriorly, glaze thin, extending scarcely halfway across base, edge free. Outer lip internally plicate. 21 × 13 mm.

Operculum thin, triangularly ovate, serrate on both margins, 5 × 3 mm. in 18 mm. shell.

White with irregular blotches and axial streaks of orange-brown, operculum pale corneous.

Radula with 70-80 rows, central plate with 10–12 cusps, the outermost one on either side minute, no intermediate plate, lateral plate without denticles between the 2 cusps.

Dead: Zululand to Algoa Bay and Agulhas Bank, 40–100 fathoms: most northerly locality off Cape Vidal (Zululand), most westerly and southerly Brown's Bank, approx. 36½° S. 21° E. (S. Afr. Mus. P.F. coll.).

Living: off Cape Natal (Durban), 54 fathoms; off Great Fish Point, 53 fathoms (S. Afr. Mus. P.F. coll.); 29° 46′ S. 31° 17′ E. 60–70 fathoms (U.C.T.).

Distribution. Off Sierra Leone (4° 24′–13° 43′ N. 7°–17° 23′ W.), 65–90 metres; off Portuguese Congo (5° S. 11° 14′ E., 55 metres) (Knudsen); off Cabinda (Franca).

Remarks. The majority of examples do not quite conform with Sowerby's description. He said the ribs number '10 on the penultimate [i.e. 5th] whorl'; this might be correct if he counted only those visible on one half of the whorl, but his figure showed 6 (or 7). I have seen one 5-whorled specimen and one juvenile taken together with a normal (as here described) specimen (off Cape Natal, 54 fathoms) with 12 axial ribs on 1st whorl, 13 on 2nd, 14 on 3rd, 16 on 4th and 18 on 5th whorl; the intervals between the ribs are consequently very obviously wider than the ribs. There is no doubt that they are conspecific, apart from there being an occasional intergrading example.

The occurrence of this species in a locality in the western Indian Ocean would not have been unexpected, but its discovery by the *Atlantide* in tropical West African waters is very surprising. The West African specimens have been compared by Knudsen with Sowerby's type material in the British Museum, and the identity may thus be accepted.

Nassa speciosa A. Ad.

Fig. 22(*c*)

1852. A. Adams. *Proc. Zool. Soc. Lond.* (for 1851), p. 100.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 26 (*plicosa*).
1907–8.* Melvill & Standen. *Tr. Roy. Soc. Edinb.*, xlvi, p. 153 (*Phos plicosa*).

* Issued separately Sept. 1907. The 1909 Report is the same as that in the Transactions, with different pagination; the original pagination is given at the foot of each page.

1909. id. *Sci. Res. Scotia*, v. p. 123 (*Phos plicosa*).
1928. Tomlin. loc. cit., p. 324 and p. 327 (*plicosus* Dnkr., non Menke).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 59 (*plicosa*).
1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), pp. 33, 46 (*plicosa*).
1936. Peile. *Proc. Mal. Soc.*, xxii, p. 140 (*plicosa*, radula mentioned).

Protoconch 2 ($2\frac{1}{2}$) whorls, diam. 0·75, alt. 0·5 mm., smooth. Postnatal whorls 8, profile nearly straight but with a sloping shoulder near top of whorl; axial ribs 12 (13) on 1st whorl, 12–13 on 2nd, 14–15 on 3rd, 4th, and 5th, 13–14 on 6th, 12–13 on 7th, and 10–12 on last whorl, suture to suture, extending across base, straight or slightly sigmoid and protractive on base of last whorl, often (in adult) additional plicae on back of outer lip but not reaching to the shoulder; crossed by spiral lirae 4–5 on 1st and 2nd whorls, 6 on 3rd, 7 on 4th, increasing to 12–15 on last whorl, the 3–4 (5) next the suture finer than the others which are variable, often wider and narrower lirae alternating, or a wide lira is divided by a fine stria; 8–9 additional lirae on base with finer intermediaries, 7–8 on rostrum, intersections with ribs on lower half of base and back of outer lip more or less nodulose. Internal parietal callus blunt, columella smooth, bluntly carinate anteriorly, glaze extending more than half-way across base, not very thick, edge adnate except on rostrum. Outer lip internally more or less plicate. 31 × 16 mm. Two examples from the same haul 28 × 16 mm. and 29·5 × 14·5 mm.

Operculum oval, margins entire, 8 × 4·5 mm. in 29 mm. shell.

Buff or cream, unicolorous, periostracum brown, columella glaze and aperture white, anterior canal purplish-brown, operculum dark brown. Animal pale, speckled with grey.

Radula with *c.* 80 rows, central plate with antero-lateral angles somewhat acutely produced, with 9 cusps, no intermediate plate, inner cusp of lateral plate with 1–3 minute denticles on its outer margin (i.e. facing the outer cusp).

Fossil, late Tertiary: Saldanha Bay. (Tomlin, Haughton).

Living (and dead): from off Umhloti River (Natal), East London, Port Alfred, Algoa Bay, Agulhas Bank, False Bay, Table Bay, to Saldanha Bay, low tide to 50 fathoms (S. Afr. Mus. P.F. coll.); 34° S. 25° 46′ E., 41 fathoms, 33° 47′ S. 26° 4′ E., 26 fathoms, 33° 3′ S. 28° 11′ E., 31 fathoms, and 31° 38′ S. 29° 34′ E., 26 fathoms (U.C.T.).

Remarks. Plump and slender forms occur. The number of axial ribs varies slightly. In beach-worn examples the shoulders of the ribs often appear as prominent white tubercles.

Von Martens stated that the margins of the operculum were serrate, but this conflicts with all the specimens in S. Afr. Mus., except in one specimen where the outer edge is crenulate, probably due to wear or corrosion.

Bisacchi (1930. *Ann. Mus. Civ. Genoa*, lv, p. 59) refers Red Sea examples to a South African variety figured, but not described, by Marrat (1877. *New Forms . . . Nassa*, pl. 1, fig. 11). This is probably a misidentification.

Nassa plebecula Gould

1860. Gould. *Proc. Boston Soc. Nat. Hist.*, vii, p. 332.
1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 6, pl. 8, figs. 4, 5 (*producta*).
1928. Tomlin. loc. cit., p. 323.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 57, and p. 57, pl. 13, no. 424 (*subcancellata*).
? 1932. id. ibid., p. 57, pl. 13, no. 423 (*erecta*).

Four worn specimens in S. Afr. Mus., with apices worn and only 5 or 6 whorls remaining. Sowerby gave the number (total) of whorls as 9, which seems a little excessive even if the protoconch were included.

On the last 4 remaining whorls the axial ribs increase regularly by one rib on each successive whorl, the numbers being resp. 11–13, 12–14, 13–15, and 14–16. The spiral lirae number resp, 4, 5, 6, and 6; the uppermost lira immediately below the suture of preceding whorl is slender, and on last whorl or 2 whorls a 7th lira may be partly visible in the suture with the following whorl. 5–6 additional lirae on base.

Sowerby said the outer lip was plicate within, and the columella rugose; his figure shows the plicae and a small parietal nodule. The present specimens show no parietal nodule, or labral tooth, or plications, the columella is smooth, and the glaze narrow.

13·5 × 5 mm. (Sowerby); 12 × 4·5 mm. (S. Afr. Mus.) Durban (Sowerby).

Distribution. Mauritius (Tomlin), Japan (Gould), Polynesia (Tomlin).

Remarks. Tomlin said the type of *producta* (in British Museum) was a poor specimen, but Sowerby's figure gives the impression of a rather well-preserved specimen.

Nassa papillosa (Linn.)

1758. Linne. *Syst. Nat.*, 10th ed., p. 737, sp. 393 (*Buccinum p.*).
1816. Lamarck. *Tabl. Encycl. Meth.*, pl. 400, figs. 2 *a*, *b*, and Liste, p. 2.
1880. Von Martens. *Mauritius & Seychellen*, p. 241.
1952. Braga. *Anais Est. Zool. Ultramar.*, vii, 3, p. 75, pl. 2, fig. 5.

Braga records this species (dead) from Mozambique. It occurs in Mauritius, Réunion, Madagascar, Aden, and Indo-Pacific.

Nassa vidalensis n. sp.

Fig. 24(*b*)

Protoconch $3\frac{1}{2}$ whorls, diam. 1·3, alt. 1·2 mm., smooth, 2nd and 3rd whorls with peripheral keel, which sinks down on last half whorl into the suture with 1st postnatal whorl, junction with 1st postnatal whorl deeply concave. Postnatal whorls 3, slightly turreted, sutures deep, profile gently convex; all whorls smooth, without any axial or spiral sculpture, except faint indications of 2–3 fine spiral striae at top of 2nd and 3rd whorls, best seen at back of outer lip, indications of 4–5 striae at bottom of base. Outer lip thickened, varicoid, feebly plicate within. 6 × 4 mm.

Off Cape Vidal (Zululand), 80–100 fathoms (S. Afr. Mus. no. A8839, P.F. coll.).

Remarks. A single unworn specimen, similar in shape to *dissimilis* Watson 1886, and *aracanensis* Smith 1899, 1901; and with carinate protoconch similar to that of *babylonica* Watson 1882, 1886, *agapeta* Watson 1882, 1886, and *psila* Watson 1882, 1886.

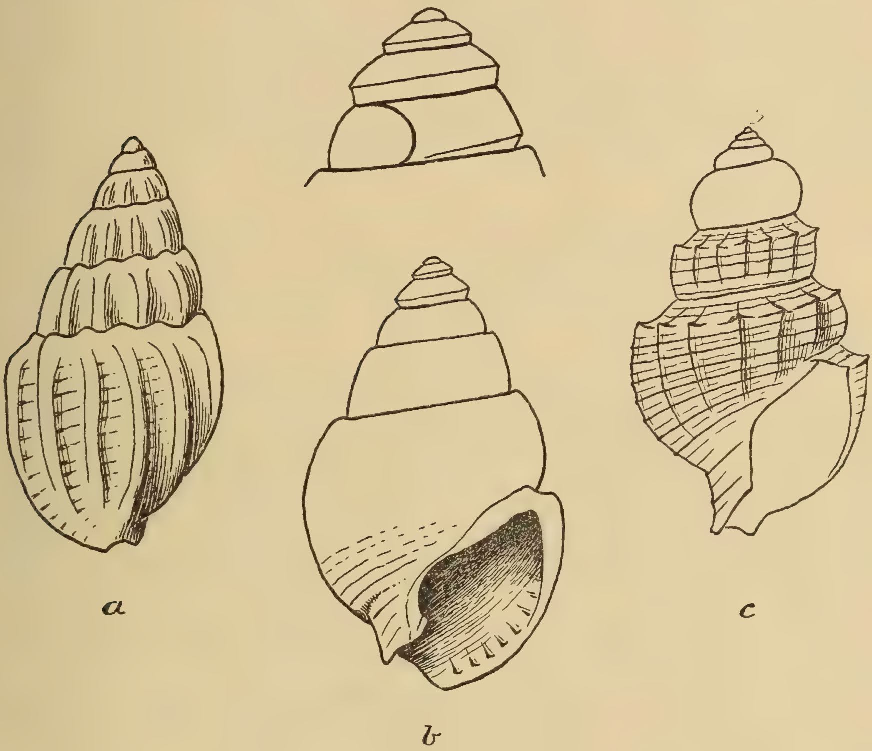


FIG. 24.
(*a*) †*Nassa scopularcus* n. sp. (*b*) *N. vidalensis* n. sp. (*c*) *Nassa* sp. juv.

Nassa kraussiana (Dnkr.)

Figs. 22(*k*), 23(*f*)

1848. Krauss. *Südafr. Moll.*, p. 123, pl. 6, fig. 18.
1906. Smith in Rogers. 10*th Rep. Geol. Comm.* (*Cape*) for 1905, p. 291.
1920. Wybergh. *Tr. Geol. Soc. S. Afr.*, xxii (1919), p. 66.
1928. Tomlin. loc. cit., p. 320 (references), and p. 327.
1936. Peile. *Proc. Mal. Soc.*, xxii, p. 140, fig. 4 (radula).
1952. Braga. *Anais Est. Zool. Ultramar.*, vii, 3, p. 75, pl. 3, fig. 3.

Broadly oval when young, obliquely ovoid and plano-convex when adult. Protoconch $1\frac{1}{2}$ whorls, diam. 0·5, alt. 0·3 mm., smooth. Postnatal whorls 4; axial ribs 14–15 on 1st whorl, 15–16 on 2nd, *c.* 16 on 3rd but feeble and evanes-

cent on later part of whorl, none on 4th whorl, but usually a few irregular plicae on back of outer lip, ribs extending from suture to suture, slightly oblique (retractive); 4–5 striae on back of outer lip anteriorly (not visible after callus is fully formed); sometimes a well-incised spiral stria in upper part of 4th whorl (distant about $\frac{1}{7}$ of height of whorl from suture) traceable back on to the 3rd and part of 2nd whorl where it is lost among the axial ribs; sometimes also 3–5 similar striae below the periphery but less distinct than those on base. Columella concave, smooth; glaze thick and extensive, when fully developed spreading over whole of base and enveloping half the shell up to apex, and forming with the callously thickened outer lip a smooth polished 'sole', the actual aperture occupying only about $\frac{1}{5}$ or $\frac{1}{6}$ part of the sole. 11 × 8 mm. 13 mm. long (Braga). Smallest example with fully developed callus 6 × 4·75 mm.

Operculum broader than long, almost semicircular, apex worn, one or two strong teeth on both margins.

Ochraceous with 3 purplish-brown spiral bands (sutural, peripheral, and basal), 'sole' white, yellowish, or (especially outer lip) purplish; back often stained green with algae.

Radula with 55–65 rows, central plate with 12 cusps and a minute one on either side externally, no intermediate plate, lateral plate with inner cusp broad, curving inwards (medianly), its inner (median) margin with 3–5 denticles.

Fossil (late Tertiary, Pleistocene, and Recent): Bredasdorp (Wybergh); Durban, Port Elizabeth, Plettenberg Bay, Knysna, Little Brak River (see Tomlin, p. 327). Also Sedgefield, near Knysna (A. R. H. Martin. *S. Afr. J. Sci.*, 52, p. 187, 1956).

Dead: Durban, Port Alfred, Port Elizabeth, Jeffreys Bay, Still Bay (auct. and S. Afr. Mus.).

Living: Keurbooms River estuary (Plettenberg Bay); Delagoa Bay (S. Afr. Mus. coll. K.H.B.). Delagoa Bay (U.W.). Inhambane, Portuguese East Africa (U.C.T.).

Remarks. This characteristic species is an estuarine and littoral species; the specimens taken in 43 fathoms off East London (recorded by Tomlin) were dead.

Peile (1936, loc. cit., and 1939, *Proc. Mal. Soc.*, xxiii, p. 276) says *sordidus*, *echinatus*, *creniliratus* and *thersites* have similar lateral plates in the radula, the last two with intermediate plates in addition.

†*Nassa scopularcus* n. sp.

Fig. 24(*a*)

1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 20 (cf. *babylonicus*).

Turreted, resembling in general *babylonica* Watson, with strong axial ribs and, at first sight, no spiral sculpture.

Whorls $5\frac{1}{2}$ (6) including protoconch (tip of which is missing); axial ribs on 2nd whorl worn, not countable with certainty, 11 on 3rd and 4th, 12 on last whorl, from suture to suture, extending over base to columella glaze, straight, their tops forming a squarish subsutural shoulder. Faint traces of spiral lirae (? 6) between the ribs on part of 4th whorl, and 13 more distinct on last portion of last whorl. Outer lip not plicate within. 14 × 7·3 mm. White.

Late Tertiary marine beds, shore of lagoon, south of Bogenfels, South West Africa (S. Afr. Mus. A9230 coll. S. H. Haughton).

This shell was seen by Tomlin, who said 'nothing Recent like it except *babylonica*, and it is quite distinct from that'. It has fewer axial ribs; and when fresh the spiral lirae would probably have been much more prominent than in *babylonica*.

Bogenfels = Arch-rock = *scopularcus*.

Nassa sp. juv.

Fig. 24(*c*)

Juv.—Protoconch 5 whorls, alt. and diam. 1·3 mm., smooth, profile of the last whorl strongly convex, not carinate, a few pliculae before the junction with 1st postnatal whorl, which is abrupt. Postnatal whorls 2, shouldered; axial ribs 13 on each whorl, forming small points at the shoulder, slightly retractive; crossed by spiral lirae on 1st whorl 1 between suture and shoulder, later 2, on 2nd whorl 2, below shoulder 3 on each whorl, on 2nd whorl one intermediary between each pair, on base 3 additional and 2 on rostrum, with intermediaries. 5·5 × 3 mm.

Protoconch and 1st whorl white, 2nd whorl pale buff, faintly brown above shoulder, and with 2 faint brown bands below, one from upper margin of aperture, the other from about middle of columella.

Off Umkomaas (Natal), 40 fathoms, one (S. Afr. Mus., Reg. No. A8888, P.F. coll.).

Remarks. Larger, 5·5 mm. with 2 (postnatal) whorls, than the East Indies *patricia* Thiele 1925, 3·5 with 3 whorls; but otherwise similar, and likewise with two brown bands. Thiele said the protoconch of *patricia* was feebly keeled on last whorl (as in *babylonica*), but in the present specimen it is not keeled and moreover is very much more prominent; in fact much like that of some Cymatiids or Bursids.

The resemblance to *arakanensis* Smith 1899 and 1901 is not so close, and here also the protoconch (especially the 5th whorl) is not nearly so prominent, and the spiral lirae are more numerous.

Although quite distinct among the South African species, this juvenile may belong to one of the numerous Indo-Pacific species, and is better left pro tem. without a name.

Gen. Demoulia Gray

1838. Gray. *Ann. Mag. Nat. Hist.*, i, p. 29.
1847. id., *Proc. Zool. Soc. Lond.*, p. 140 (*Desmoulea*).
1928. Tomlin. *Ann. S. Afr. Mus.*, xxv, p. 326.
1929. Thiele. *Handbuch*, i, p. 323 (*Desmoulea,* subgen. of *Nassa*).

Demoulia abbreviata (Gmelin)

Fig. 22(*l*)

1928. Tomlin. loc. cit., p. 326.
1932. Turton. *Mar. Sh. Pt. Alfred,* p. 60, pl. 14, no. 441 (juv.).

Subglobular, with numerous conspicuous spiral costae. Protoconch 2 whorls (tip missing), diam. 1·25–1·5 mm., smooth. Postnatal whorls 6 (7). Periostracum thin, fibrous-fimbriate. 38 (protoconch missing) × 28 mm.; plump and slender forms 33 × 26 mm. and 35 × 24 mm.

Operculum thin, triangular, edges scarious, 9 × 9 mm. in 30 mm. shell.

White, periostracum brown, operculum amber.

Radula with *c.* 95 rows, central plate with 9 cusps, lateral plate with inner cusp slender.

An egg-capsule removed from oviduct of animal in 30 mm. shell was 13 mm. in length, and 3–3·5 mm. in cross-section, cylindrical, somewhat triquetral in section (but this may not be the true shape when the capsule has been laid and has hardened).

False Bay to Algoa Bay and Natal, 18–52 fathoms (Tomlin, S. Afr. Mus. P.F. coll.). St. Francis Bay, 80–100 metres (von Martens).

Living: False Bay, 27 fathoms; off Knysna, 52 fathoms; Algoa Bay, 31 fathoms (S. Afr. Mus. P.F. coll.).

Demoulia retusa (Lam.)

1816. Lamarck. *Tabl. Encycl. Meth. Livr.*, iv, pl. 394, figs. 3 *a*, *b*, and Liste, p. 1. (*Nassa ventricosa* n. et f. only) (not Livr. iii, 1827, as given by Tomlin).)
1822. id. *Anim. sans Vert.*, vii, p. 270 (*Buccinum r.*).
1928. Tomlin. loc. cit., p. 326.

Ovoid, with numerous fine spiral lirae. Protoconch 2 ? whorls (tip missing), diam. 1·3 mm., smooth. Postnatal whorls 5 (6). Periostracum thin, smooth. 27 (protoconch missing) × 19 mm.

Variously blotched and marked with brown, usually two speckled spiral bands and 'necklace' of dark and pale spots at top of whorls, periostracum pale brown.

False Bay, Agulhas Bank, and Zululand, 5–55 fathoms (Tomlin, S. Afr. Mus. P.F. coll.).

Three living specimens were obtained by the *Pieter Faure* in False Bay, 5 fathoms, but the animals were not preserved.

Gen. Bullia Griffith

1834. Griffith in *Cuv. Anim. Kingd.*, xii, pl. 37.
1840. Swainson. *Treat Malac.*, p. 302 (*Leiodomus*).
1841. Gray. *Proc. Zool. Soc. Lond.*, xv, p. 139 (*Dorsanum*).
1929. Thiele. *Handbuch*, i, p. 322.
1937. Peile. *Proc. Mal. Soc.*, xxii, p. 183 (radulae) (also comments on Thiele's arrangement).
1938. id. ibid., xxiii, p. 6 (radula).

Protoconch, junction with 1st postnatal whorl not sharply demarcated. Operculum with apical nucleus, but shape variable: of more or less normal size, subtriangular, margins entire or serrate; or ovate with incurved apex; or much reduced in size.

Animal with large foot capable of considerable expansion, its antero-lateral corner more or less pointed (tentaculate) (*Bullia*) or rounded (*Dorsanum*), posteriorly with two 'tails' (*Bullia*) or without tails (*Dorsanum*); eyes present (*Dorsanum*) or absent (*Bullia*).

Radula formula 1.1.1, central plate with several cusps, lateral plate with 2 large cusps, the inner one bifurcate (*Bullia*) or trifurcate (*Leiodomus*) or with additional denticles between it and the outer cusp. Considerable variation occurs in the cusps of the lateral plates, even in the same radula (cf. Peile, 1937), and this fact is somewhat against Peile's argument for separating *Leiodomus* from *Bullia* (loc. cit., p. 184).

The radulae of eleven species, including those already described by Peile, are here described and nine of them are figured.

Remarks. Many parts of the South African coast, where sandy beaches occur, await exploration, and doubtless will yield interesting results. Needless to say: *living* animals are required for study.

With the exception of the egg-capsule of *tenuis* described below, the reproduction and life-history of these arenicolous molluscs seem to be unknown. I have found juveniles of *rhodostoma* as small as 4 mm. long in the shifting sand between tide marks. Do the adults (of the littoral species) retreat off-shore to less turbulent water for spawning, or do they burrow deeply between tide marks?

Ancilla osculata Sow. is transferred to the present genus, and the suggestion is made (see also p. 62) that *Bullia ancillaeformis* Smith is really an *Ancilla*.

Key based on the operculum

I. Operculum of more or less normal size.
  A. Margins serrate.
    1. Shell crimped at sutures . . . . *similis*
    2. Shell not crimped . . . . *digitalis*
  B. Margins smooth.
    1. Subtriangular, apex truncate or excavate . . . . { *osculatata* / *annulata*
    2. Ovate, apex subacute, incurved.
      a. Almost completely filling aperture . . . . *natalensis*
      b. Not completely filling aperture.
        i. Shell smooth . . . . *rhodostoma*
        ii. Shell lirate . . . . *pura*
        iii. Shell pustulose . . . . *mozambicensis*

II. Operculum much reduced in size.
- A. Aperture of shell longer than spire . . . . *laevissima*
- B. Aperture subequal to spire. Parietal callus thick . . . . *callosa*
- C. Aperture less than spire (adult). Parietal callus thin . . . . . *tenuis*

Operculum unknown: *diluta*, *trifasciata*, *tenuistriata*, *ancillaeformis*,* *dulcis* Sow., (= *digitalis*), *almo* Bartsch (= *digitalis*), *lara* Bartsch (= ? *tenuis*), *aepynota* Bartsch (= ? *diluta*), *alfredensis* Bartsch (= *diluta*); and all Turton's 'species'.

Bullia similis Sow.

Figs. 25(*i*), (*j*), 27(*a*)

1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 5, pl. 7, fig. 1.

Aperture 1–1⅓ times in spire. Protoconch diam. 0·3–0·5 mm. Whorls (total) 8 (8½). Parietal callus thin and narrow, not extending on to preceding whorl or visible at suture. Whorls smooth with a spiral sulcus near suture, the lira thus demarcated producing with the growth-lines a crimped or beaded sculpture beginning (clearly visible) from about 4th whorl; 6th whorl with 1–3 (4) very fine spiral striae, increasing to 6–7 on 7th whorl and 8–9 (sometimes 10–11) on last whorl, becoming stronger and easily visible on the latter, especially on upper and lower parts of whorl; on last whorl the crimping extends on to the lira below the sutural lira; growth-lines fine and close, making the striae punctate, especially on base; 7–8 additional striae on base, becoming stronger (sulci) near rostrum. Columella glaze thin. 26 × 11 mm. 31 × 15 mm. (Sowerby).

Operculum thin, triangularly ovoid, both margins serrate, 6 × 3·5 mm. in 21 mm. shell with 9 mm. aperture.

Cream or buff, with very faint orange or fawn undulate, arcuate, or zigzag axial flames.

Radula with about 60 rows, central plate subequal in width to lateral plate, base (excl. cusps) about 2½ times as wide as long, with 11 cusps, sometimes a minute denticle externally on one side or the other, lateral plate with inner cusp bifurcate, outer prong a little smaller and more slender than the inner (median) prong, sometimes a minute denticle between the prongs, outer prong itself sometimes bifid or bifurcate.

Fossil: raised beach, alt. 375 ft. at Durban-Umgeni (Geol. Surv.).

Living: off Cone Point (between St. Lucia and Durnford Bays, Zululand) to off East London, 12–27 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. Close to *belangeri* Kien. in coloration, but the latter, as already remarked by Sowerby, has no crimping near the suture; also (Ceylanese specimens in S. Afr. Mus.) the middle portion of the whorls is without spiral striae.

* See note under *Ancilla bullioides*, p. 62.

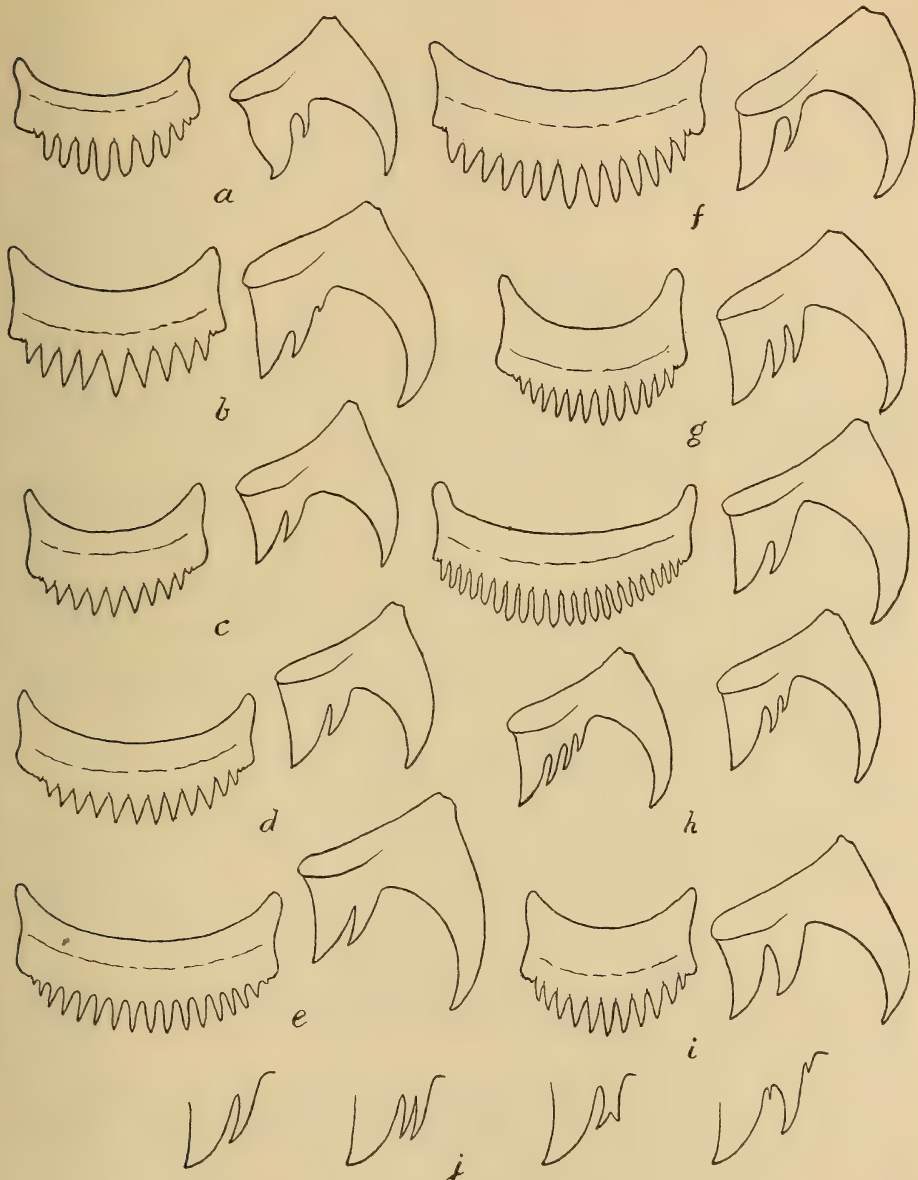


FIG. 25.

Central and lateral radula plates of *Bullia* (*a*) *pura* Melv.; (*b*) *tenuis* Gray; (*c*) *natalensis* (Krss.); (*d*) *mozambicensis* Smith; (*e*) *digitalis* Meuschen; (*f*) *annulata* (Lam.); (*g*) *rhodostoma* Rve.; (*h*) *laevissima* (Gmelin), with variants of lateral plate; (*i*), (*j*) *similis* Sow., with variants of inner cusp of lateral plate. In (*j*) the right-hand one is from the same radula as figured above; the three on the left are all from another radula.

Bullia osculata (Sow.)

Fig. 27(*b*)

1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 3, pl. 1, fig. 6 (*Ancilla o.*).
1903. Smith. ibid., v, p. 364 (*Ancilla o.*).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 35 (*Ancilla o.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 32, pl. 7, no. 243 (*Ancilla o.*).

Aperture 1–1¼ in spire. Whorls 6–7. Parietal callus thin and narrow, not extending on to preceding whorl and not visible at sutures. A single shallow and inconspicuous spiral stria immediately below the suture, and 2–3 on lower part of base (excluding those on rostrum). Columella glaze thin. 19 × 8 mm. Turton: 21 mm. long.

Operculum triangularly ovoid, margins smooth, apex truncate, 3·5 × 2 mm. in shell 14 mm. with aperture 5·5 mm.

Cream, with flame-like markings below the suture and around base, in addition with axial undulate lines (Turton, and S. Afr. Mus.); in the Cape Vidal specimens these lines are strongly zigzag.

Foot with antero-lateral corners rounded (but ?, only one example available), posteriorly with 2 well-developed 'tails', no eyes. Radula very like that of *similis*, with 55 rows, central plate about twice as wide as long (excl. cusps), with 11 cusps, the outermost one on one side minute, lateral plate subequal in width to central, inner cusp with both prongs stout, the inner larger than the outer.

Living: off Cove Rock (East London area), 22 fathoms (S. Afr. Mus. P.F. coll.).

Dead: Pondoland, the Kowie, Port Alfred (Sowerby, Bartsch, Turton). Cape Vidal, Zululand, 50 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. Topotypes in S. Afr. Museum. The Cape Vidal specimens were identified by Sowerby, but not recorded.

Sowerby commented on the likeness of his species to a *Bullia*; indeed it seems surprising that he referred it to *Ancilla* because it lacks the basal groove characteristic of the *Olividae*. Neither Smith nor Bartsch queried its generic position. I had previously transferred it to *Bullia* on conchological grounds, but now a specimen containing the animal, found in one of the P.F. bottom-samples, settles the question.

Sowerby distinguished *similis* from *belangeri* Kien., but the present species is much nearer to the latter. Two Ceylanese specimens in S. Afr. Mus. (ex coll. Ross-Frames), 35 mm. long, have axial lines and flames, but they have two spiral striae at the top of each whorl, distinct from the early whorls onwards, the upper one of which becomes a sulcus on the later whorls; there are also 2 striae on lower part of the whorl.

The species is very like a slender form of *annulata* (of equal size and before the typical shoulder of the later whorls has developed), especially smooth examples in which the spiral striae are inconspicuous and obsolescent.

Bullia tenuistriata Tomlin

1920. Tomlin. *J. Conch.*, xvi, p. 87, text-fig. 4.
1923. id. ibid., xvii, p. 46.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 64.

Aperture about $1\frac{1}{3}$–$1\frac{1}{2}$ times in spire (as figured). Sutures deeply impressed; presumably therefore the parietal callus is thin and not visible on the preceding whorl. 17 spiral striae on penultimate whorl, and 15 on each of the preceding whorls, interstices smooth. Otherwise similar to *pura*. 16·5 × 6·5 mm. Turton: 25 × 10 mm.

Port Alfred.

Described from two dead specimens. Turton later found a larger one.

Remarks. Tomlin said it had 'some slight resemblance' to *pura*. In my opinion it has a very strong resemblance, amounting almost to identity. Compared with some specimens of *pura* in which the intermediary lirae are well developed (total number of lirae 15–17!) the only distinguishing feature is the sunken suture of *tenuistriata*, and that may well be only an individual aberration (cf. *alfredensis* Bartsch and *scalaris* Turton, both = *diluta*).

Bullia trifasciata Smith
Fig. 27(*f*)

1904. Smith. *J. Malac.*, xi, p. 34, pl. 2, fig. 17.

Distinguished from *annulata*, apart from the coloration, by being spirally striate from the 2nd whorl onwards, and by the uppermost stria (juv.) or (older specimens) the 2 uppermost striae being *on the actual turgid shoulder*.

Apex blunter, 1st whorl diam. at least 1·5 mm. (*annulata*: 1 mm.). Whorls (total) 7, turreted or pagoda-like, profile below shoulder almost straight (at least in later whorls). In perfectly fresh specimens the spiral striae could probably be traced on the 1st whorl (I have seen only worn specimens); on 2nd whorl 7 striae, on later whorls 8, 7–8 additional ones on base. 32 × 15 mm. Smith: 39 × 18 mm.

Operculum and animal unknown.

Brown with 3 darker spiral bands, that on the shoulder being the darkest; bleached specimens white with the bands more or less visible.

Dead: Port Alfred (Smith, Bartsch, Turton); Still Bay (S. Afr. Mus. coll. Muir).

Remarks. Smith did not mention the one essential difference in the spiral sculpture between this species and *annulata*.

Bullia annulata (Lam.) Rve.
Figs. 25(*f*), 27(*e*)

1816. Lamarck. *Tabl. Encycl. Meth.*, p. 399, figs. 4 *a*, *b*, Liste, p. 2 (*Buccinum a.*, nom. et fig.).
1846. Reeve. *Conch. Icon.*, iii, Bullia no. 13.
1902. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 95, pl. 2, fig. 4 (with animal).
1903. Von Martens. *D. Tiefsee Exp.*, vii, pp. 28, 53.

1913. Bullen Newton. *Rec. Albany Mus.*, ii, p. 344, pl. 23, figs. 3, 4.
1937. Peile. loc. cit., pp. 183, 184, fig. 17 (radula).

Aperture in juv. subequal to spire, later $1\frac{1}{5}$–$1\frac{1}{3}$ in spire. Apical whorl diam. 0·75–1 mm. Whorls (total) 9 ($9\frac{1}{2}$), turreted or pagoda-like, profile below shoulder slightly convex. Parietal callus thin, not extending on to preceding whorl nor visible at suture on early whorls, but on later whorls often visible as a narrow irregularly undulate excrescence between suture and preceding whorl (sometimes visible and invisible on different parts of the same shell). No sculpture on first 5 whorls except from 2nd whorl onwards a single spiral stria on upper part of whorl near suture; on 6th and later whorls the subsutural stria becomes a sulcus and is followed by 7–8 striae across the whole whorl, on last 2 or 3 whorls these striae become stronger and can also be called sulci; the lira adjoining the suture from the 4th or 5th whorl onwards becomes stronger and forms a tabulate shoulder varying in strength, sometimes sloping, sometimes projecting almost perpendicular to the preceding whorl; 9–10 additional striae (sulci in large examples) on base. Anterior end of columella prominent, angularly carinate; glaze thin. 23 × 12 mm. 36 × 19 mm., 45 × 22 mm., 60 × 28 mm.; smallest specimen examined 4 × 2·75 mm. (but see *infra*).

Operculum in adult broadly triangularly ovoid, margins entire, apex truncate; in juveniles obliquely oblong, broader than long, apex excavate between 2 small points; 10 × 8 mm. in 39 mm. shell with 16 mm. aperture; juv. 2 × 3 mm. in 13 mm. shell with 6 mm. aperture.

Buff or fawn, with violaceous (darker fawn or fulvous in dead shells) marks on the shoulder, which frequently, especially in juveniles and half-grown examples, extend across the whorls as axial streaks and flames; operculum amber-brown.

Foot with antero-lateral angles pointed (or tentaculate, depending on the preservation), posteriorly with 2 long 'tails', no eyes. Radula with 85–90 rows, central plate about $1\frac{1}{2}$ times as wide as lateral plate, base (excl. cusps) about $3\frac{1}{2}$ times as wide as long, with 12 cusps, lateral plate with inner cusp bifurcate, its outer prong smaller and more slender than inner (median) prong.

Animal pale greyish, livery, or flesh-coloured.

Fossil, Mio-Pliocene: Redhouse near Rort Elizabeth (Newton).

Port Alfred (Bartsch, Turton); St. Francis Bay, 80–100 metres (von Martens); off Nieca River (East London area), 43 fathoms, 1 dead (S. Afr. Mus. P.F. coll.).

Living: False Bay, 18–20 fathoms; off Cape St. Blaize, 19 fathoms; Algoa Bay, 10–24 fathoms (S. Afr. Mus. P.F. coll.). Knysna and Algoa Bay (U.C.T.); 34° S. 25° 46′ E., 41 fathoms and 33° 47′ S. 26° E., 26 fathoms (U.C.T.).

The typical form has not been recorded farther east than Port Alfred and East London area, and farther west than False Bay.

Remarks. Sowerby's 1902 figure of the animal shows the two long 'tails', but not the true shape of the operculum.

Examples 10–11 mm. long with 5 whorls and the beginning of the 6th are the smallest I have seen which can without doubt be referred to this species, as they have striae on the middle of the last whorl. Below this size owing to the absence of these striae juveniles are not separable with certainty from juveniles of *laevissima*, although in the latter at an early stage the length of the aperture exceeds that of the spire.

Peile figured the radula of a juvenile 'just emerging from the earliest stages of growth'.

The Algoa Bay specimen recorded by von Martens as *mauritiana*, a species closely resembling *annulata*, is probably a misidentification.

There are 3 typical specimens in S. Afr. Mus. from Zanzibar, collected by E. L. Layard, on board H.M.S. *Castor*, 1856. Also a specimen from 'East Africa' (ex coll. Ross-Frames) not so strongly shouldered as typical specimens.

One specimen 23 × 12 mm., 7 whorls, from Still Bay (coll. Muir) is very smooth. The 6th and 7th whorls each have only 2 striae (one below the shoulder and one other), only the later part of the 7th whorl has faint traces of the usual 7–8 striae, and those on lower part of base are only moderately strong (normally they are strong enough to be called sulci). Although this specimen is a normal *annulata* in shape (proportions), the suppression of the spiral striae connects it with the following form or variety from the Natal coast.

Variety. In general similar to typical form but more slender and less strongly shouldered, especially on the earlier whorls. The 7th and 8th whorls show traces of the 2 striae at the top of the whorl, but even on the 8th whorl the upper one below the shoulder is very shallow and can scarcely be called a sulcus. In the largest specimen traces of 2 more striae on the upper part, and one or two on the lower part of the 8th whorl can be seen; and 7–8 additional ones on base, the lowermost of which are very shallow sulci.

Operculum as in *annulata*. Coloration as in *annulata*.

24 × 10·5 mm., 35 × 16 mm., 38 × 16·5 mm., 39 × 18 mm., and 43 × 19 mm. (contrast measurements given above for typical form).

Natal: fresh and somewhat worn specimens off Umkomaas, 13 fathoms; one fresh specimen off Durban, 54 fathoms; one fresh specimen off Tugela River, 37 fathoms; one with operculum (presumably taken alive, though animal not preserved) off Umhloti River, 27 fathoms (S. Afr. Mus. P.F. coll.).

Von Martens (1903) recorded *annulata* from Natal.

Tomlin saw the Tugela specimen and labelled it '*annulata* var.'.

†*Bullia magna* Haughton

1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 46, pl. 5, figs. 1, 4, 5.

Described from Quaternary deposits 20 miles north of the Orange River mouth, and from two localities near the Olifants River mouth.

Except for the absence of shoulders the shells might be *annulata*, and the anterior end of the columella projects prominently inwards as in this species,

but the parietal callus forms a ring 'behind the posterior margin of each whorl', which it does not in *annulata*.

Moreover *annulata* has not been recorded from the west coast.

Bullia tenuis Gray

Figs. 25(*b*), 26, 27(*g*)

1828. Wood. *Suppl. Index Test.*, p. 12 (nom et fig.).
1839. Gray. *Zool. of the 'Blossom'*, p. 128.
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 29.
? 1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 53, pl. 38, fig. 3 (*lara*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 61 and p. 61 (*lara*).

Aperture a little longer than spire (juv. 4 mm.), subequal to spire (*c.* 12 mm. shells), and a little less than spire ($1\frac{1}{6}$ times in spire) in larger shells. Apical whorl (protoconch) diam. 0·8–1 mm. Whorls (total) 8. Parietal callus on 3rd whorl extending $\frac{1}{4}$ of whorl above suture forming a prominent costa, less prominent on 4th whorl, and from 5th or 6th onwards forming only a thin glaze extending $\frac{1}{4}$–$\frac{1}{3}$ length of preceding whorl. On 4th and following whorls spiral striae over whole whorl, stronger at top and bottom, on later whorls (3) 4–5 at top and 4–5 at bottom persist but striae obsolescent on peripheral area, the striae at top closer together than those below, 8 additional striae on base. Columella glaze thin but extending over whole base and rostrum. 60 × 28 mm., smallest examined (beach-worn) 4 × 2·75 mm.

Fig. 26.

Bullia tenuis Gray. Egg-capsule with embryo. Central plate of the 1st, 5th, and 10th rows of the radula of this embryo.

Operculum very small, oval or slightly triangularly ovoid, 4·5 × 2·5 mm. in shell 60 mm. with 28 mm. aperture.

Cream or ochraceous, protoconch and apical whorls often with a livery tinge; operculum amber.

Foot with antero-lateral corners very shortly pointed, posterior tails small, no eyes. Radula with 75–85 rows, central plate $1\frac{1}{4}$ times as wide as lateral plate, its base 3–$3\frac{1}{2}$ times as wide as long, with 9 cusps and a denticle externally on one or both sides; lateral plate with inner cusp bifurcate, outer prong with 1–3 denticles or serrulations on its outer edge.

Animal purplish-grey or flesh-coloured, edge of foot pale.

Four egg-capsules were taken by U.C.T. in False Bay on 29 July 1952. They are thin and membranous, soft, transparent, with an attachment thread at each end, one of the threads being less coiled than the other on all four capsules. One capsule contained numerous eggs, *c.* 0·2 mm. diam.; the others only one shell each.

Shell 5·3 × 3·5 mm., aperture 3·3 mm., operculum 0·75 × 0·5 mm.

Radula with 38 rows, central plate of 1st row with 3 cusps, of 5th row with 5 cusps, of 10th row with 7 cusps, thereafter from about the 12th row with 9 cusps; inner cusp of the lateral plate of the first two or three rows simple, thereafter bifurcate, sometimes trifurcate.

False Bay to Port Alfred (auct.). Port Natal (Durban) (von Martens, coll. Heynemann in Berlin Mus.).

Living: Algoa Bay (von Martens); False Bay and Mossel Bay (U.C.T.); False Bay to off Great Fish Point and Port Alfred, 9–66 fathoms (S. Afr. Mus. P.F. coll.); 33° 47′ S. 26° E., 26 fathoms, and 33° S. 28° 11′ E., 31 fathoms (U.C.T.).

Remarks. The ridge-like callus on 3rd and 4th whorls is distinctive.

There are plump and slender forms, e.g. 31 × 16 and 34 × 15 mm., 47 × 25 and 50 × 23 mm. One specimen is slightly turreted owing to a small rounded shoulder below the suture on the later whorls.

B. lara Bartsch is probably synonymous, though it is said (by Turton) to lack the callus ridge, and (as far as can be judged from Bartsch's figure) the columellar glaze is not nearly so extensive.

Haughton (1932. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 47, pl. 5, fig. 2) has recorded this species, identified by Tomlin, from Quaternary raised beaches near the mouths of the Orange River and Olifants River. The figure shows a shell shaped more like *digitalis* than *tenuis*; and on the west coast the occurrence of *tenuis* seems rather unlikely.

Bullia pura Melv.

Figs. 25(*a*), 27(*c*)

1885. Melvill. *J. Conch.*, iv, p. 316.
1921. Sowerby. *Proc. Mal. Soc.*, xiv, p. 127 (var. *balteata*).
1931. Tomlin. *Ann. Natal Mus.*, vi, p. 430.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 61, pl. 14, no. 447, and var. *balteata*, p. 61, pl. 14, no. 448.
1932. id. ibid., p. 61, pl. 14, no. 449 (*kraussi*).
1937. Peile. loc. cit., p. 184, fig. 18 (radula).

Aperture $1\frac{1}{4}$–$1\frac{1}{2}$ times in spire. Apical whorl (protoconch) diam. 0·5 mm. Whorls (total) 9 (10); profile of shell from apex to body whorl slightly concave. Parietal callus thin, not visible above suture except on last whorl (or last part of last whorl), where it extends only a short distance $\frac{1}{8}$–$\frac{1}{7}$ on to preceding whorl, but just before and at the aperture it spreads out slightly to $\frac{1}{4}$ length of preceding

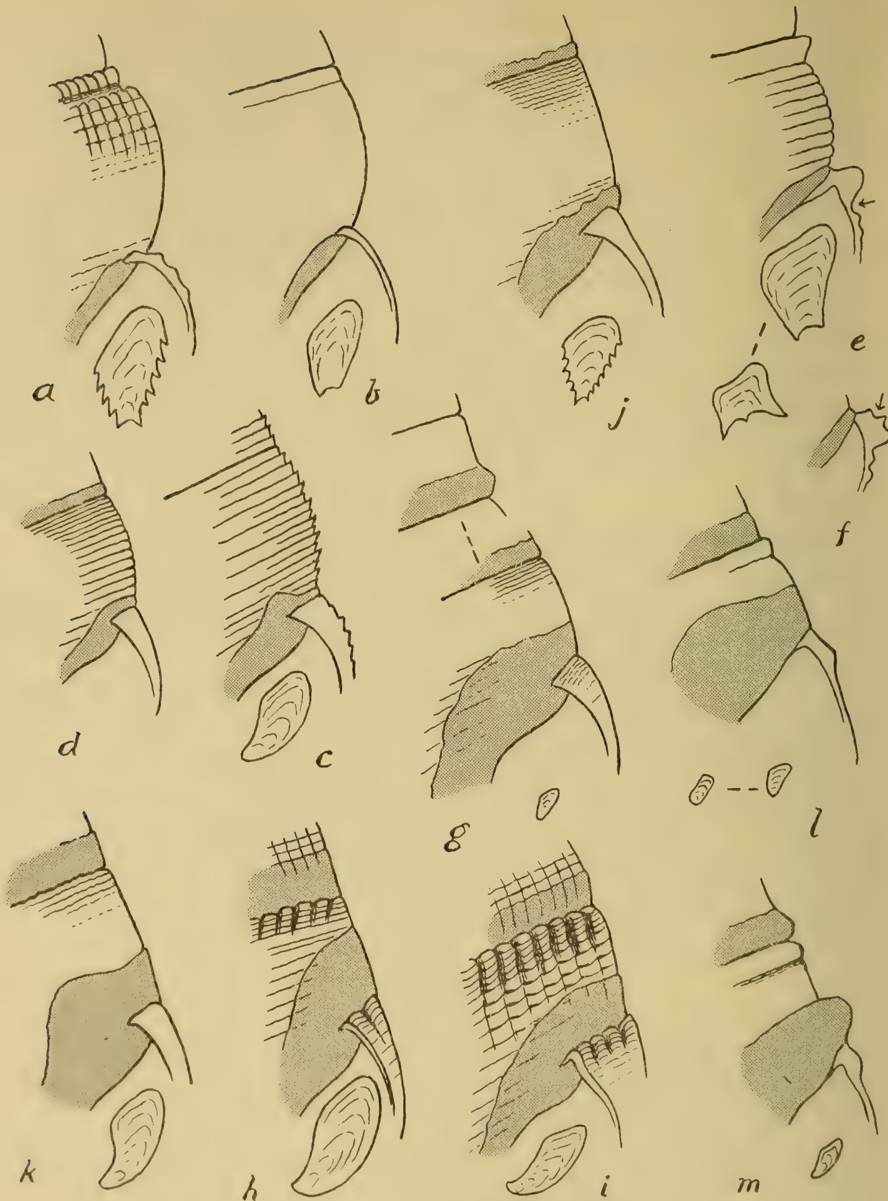


FIG. 27.

Portions of penultimate and ultimate whorls, and aperture of *Bullia* to show parietal callus (stippled) and sculpture. Opercula included when known. (*a*) *similis* Sow. (*b*) *osculata* (Sow.). (*c*) *pura* Melv. (*d*) *diluta* (Krss.). (*e*) *annulata* (Lam.) Rve., with operculum of juvenile. (*f*) *trifasciata* Smith, posterior part of aperture. (*g*) *tenuis* Gray, with 3rd whorl above. (*h*) *natalensis* (Krss.). (*i*) *mozambicensis* Smith. (*j*) *digitalis* Meuschen. (*k*) *rhodostoma* Rve. (*l*) *laevissima* (Gmelin), with variant of operculum. (*m*) *callosa* (Gray) Rve.

whorl above the suture. First 2 ($2\frac{1}{2}$) whorls smooth; on 3rd and following whorls 7–9 spiral lirae, on the later whorls often with intermediaries, 5—6 (7) additional lirae on base, also sometimes with 2–3 intermediaries. Columellar glaze thin, spreading slightly above posterior canal, covering rostrum but not more than about $\frac{1}{3}$ of base. 33 × 13 mm., smallest example seen 1·75 × 1 mm. (3 whorls). Turton: 35 mm.

Operculum ovate, apex incurved, a slight sigmoid ridge or thickening on inner surface near inner (left) margin, margins smooth, 4·5 × 2·75 mm. in shell 22 mm. with 13·5 mm. aperture.

Cream or buff, sometimes with a white band below suture (*balteata*), sometimes with irregular faint brown marks around periphery of last whorl or last two whorls; operculum amber.

Radula with *c.* 60 (half-grown)–75 rows, central plate about $1\frac{1}{3}$ times as wide as lateral plate, its base $4\frac{1}{2}$–5 times as wide as long, with 10 rather stout and bluntish cusps (throughout the radula, not only the anterior ones which get blunted by wear); lateral plate with inner cusp stout, bifurcate, inner prong broad with sinuous inner margin, outer prong slender.

Fossil: raised beaches at Keurbooms River estuary (K.H.B. 1931).

Dead: Port Alfred and Port Elizabeth (Sowerby, Bartsch, Turton). Still Bay (S. Afr. Mus. coll. Muir).

Living: False Bay (S. Afr. Mus.).

Remarks. The tapering spire due to the slenderness of the early whorls contrasted with the rather disproportionate width of the last whorl, producing the concave profile of the shell as a whole, is distinctive.

The shape of the inner cusp of the lateral plate of the radula is, so far as is known, unique among the South African species.

B. tenuistriata Tomlin (*supra* p. 127) is probably synonymous, based on examples in which the intermediary lirae are specially well developed and the sutures abnormally sunken.

Bullia diluta (Krss.)

Fig. 27(*d*)

1848. Krauss. *Südafrik. Moll.*, p. 121 (*Buccinum d.*).
1874. Von Martens. *Jahrb. D. Malak. Ges.*, i, p. 137, pl. 6, fig. 4 (var. *mediolaevis*).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 53, pl. 35, fig. 5 (*aepynota*, subturriform).
1915. id. ibid., p. 54, pl. 3, fig. 2 (*alfredensis*).

Probable other synonyms are Turton's: *albanyana* (subturriform), *rietensis*, *zenobia*, *subventricosa* (subturriform), *spectrum*, *scitula*.

Aperture $1\frac{2}{3}$–$1\frac{3}{4}$ (half-grown) to 2 times in spire. Angle of spire 20°–25°. Apical whorl (protoconch) diam. 0·75 mm. Whorls (total) 9. Profile of whole shell straight. Parietal callus thin, extending up $\frac{1}{6}$–$\frac{1}{7}$ of length of preceding whorl and visible from (5th) 6th whorl onwards (best seen in worn specimens!). Spiral striae over whole whorl from 3rd whorl onwards, *c.* 15 on last whorl, but often with fine intermediaries, striae closer together on upper part of

whorl; 5–6 additional spaced striae on base. Columellar glaze thin, not extensive, not covering rostrum. 29 × 10 mm.

Operculum and animal unknown.

Cream or fawn, with a series of orange-brown spots in upper third of whorls, continued downwards as axial streaks (as if the spot of colour had 'run'), the costa on base from columella to end of aperture orange-brown, sometimes showing through at the suture of following whorl, the ground-colour above the spots often paler (whitish) than the lower part of whorls.

Natal (Krauss); Port Elizabeth (Sowerby, Bartsch); Port Alfred (Bartsch, Turton). Port Alfred, East London, Port St. Johns, Scottburgh (Natal), Durban, Tongaat (30 miles N. of Durban) (S. Afr. Mus.). Delagoa Bay (U.W.).

False Bay (von Martens: var. *mediolaevis*).

Remarks. A common species with several minor variations in coloration and convexity of the whorls, sometimes subturriform (*aepynota*, *subventricosa*, *scitula*), which have been given names as distinct species.

The specimens described by von Martens as var. *mediolaevis* from the Fritsch collection were stated to have come from False Bay. But there is no other record from any locality west of Algoa Bay; perhaps Dr. Fritsch obtained the specimen from a friend.

Bullia natalensis (Krss.)

Figs. 25(*c*), 27(*h*), 28

1848. Krauss. *Südafrik. Moll.*, p. 121, pl. 6, fig. 16 (*Buccinum n.*).

Aperture $1\frac{1}{4}$—$1\frac{1}{3}$ in spire. Diameter of protoconch 0·5, of 1st whorl 1·25, of 2nd 1·5, of 3rd 1·75 mm. Whorls (total) 8. Profile straight, slightly concave near apex. Parietal callus thin, visible but very narrow on 3rd whorl, on 4th extending up $\frac{1}{5}$–$\frac{1}{4}$ length of preceding whorl, on 5th $\frac{1}{3}$, on 6th $\frac{1}{2}$, and on 7th and 8th $\frac{2}{3}$. First 3 whorls smooth; fine axial slightly curved plicae on 4th and 5th, somewhat irregular, becoming stronger on later whorls, where they form a strong crenulation at the suture, but obsolescent on middle and lower part of whorl, about 22 on last whorl. Spiral striae on 4th and following whorls, about 13 on 4th whorl, 15 on 5th, closer together at top of whorl, on later whorls less conspicuous and concealed by the increasing width of the callus, 3–4 additional inconspicuous striae on base. Columella evenly curved, without keel or bend; glaze thin, covering about $\frac{1}{3}$–$\frac{1}{2}$ base. 34 × 13 mm. (8 whorls). A larger specimen 41 × 17 mm. (apex worn, 4 whorls remaining, probably 43–44 mm. long when perfect).

Operculum nearly filling aperture, ovate, apex incurved, margins smooth, 5 × 2·5 mm. in shell 15 mm. with 6 mm. aperture.

Cream or flesh-coloured, sometimes slightly livid in middle of whorl, basal costa yellowish, aperture orange within, pale at margin of outer lip, operculum amber.

Foot with antero-lateral corners shortly pointed, posteriorly with 2 tails, no eyes. Radula with 55 (14 mm. shell)–65 rows, central plate slightly wider than lateral plate, its base 3–3½ times as wide as long, with 9–10 cusps; lateral plate with inner cusp bifurcate, the outer prong smaller and more slender than the inner (median) prong. Animal pale flesh-colour.

Fossil: raised beach, alt. 375 ft. Durban-Umgeni (Geol. Survey).

Dead: Durban (Krauss). Durban and Tongaat (S. Afr. Mus.).

Living: Durban (S. Afr. Mus. coll. K.H.B.); Umhlali and Karridene (Natal) (U.C.T.), Delagoa Bay (U.W.).

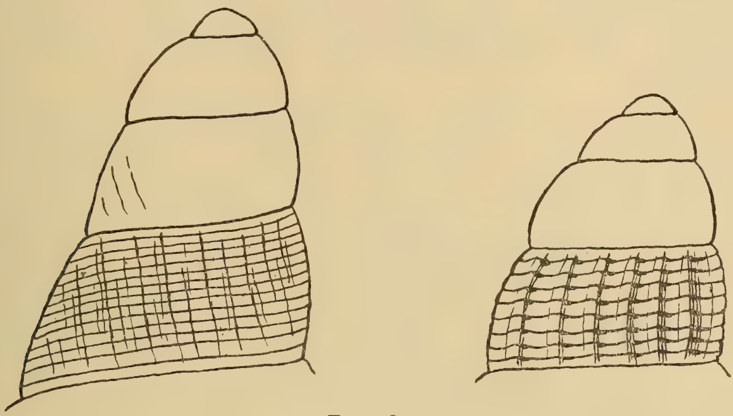


FIG. 28.

Protoconch and upper whorls of (*left*) *Bullia natalensis* (Krss.), and (*right*) *B. mozambicensis* Smith. Length of portion figured 3 mm. and 2 mm. respectively.

Remarks. Distinguished from *mozambicensis* by the apical three smooth whorls being more elongate and papilliform, and by the sculpture of the early whorls being cancellate but not pustulose, and by the lack of spiral striae on base of last whorl. The operculum very nearly fills the aperture, and relatively is larger than in any other South African species.

The parietal callus band is also, relatively, wider than in other South African species.

This species does not, according to the few records, occur south of Durban.

Aberr. gigant. In S. Afr. Mus. (ex coll. Ross-Frames) is one very large shell said to have come from the mouth of the Limpopo River (Chai Chai, Portuguese East Africa), together with one undoubted *mozambicensis.* It measures 60 × 24 mm.; 6 whorls remain, the apex is worn and 2, possibly 3, whorls are missing. It agrees in sculpture and shape of columella with *natalensis.* The parietal callus extends only ⅓ in the 2nd remaining whorl, but rapidly widens to ½ on the 3rd and equally rapidly to ⅘ on the 4th, leaving only the sutural crenulations exposed; near the end of the 4th whorl it drops abruptly to ⅓ on 5th, and continues thus on the 6th.

The sutural diameter of the 8th whorl of the 34 mm. shell is 10 mm.; if the 41 mm. shell (recorded above) be assumed to have had $8\frac{1}{2}$ whorls the diameter of the 8th whorl is also 10 mm.; and the diameter of the $8\frac{1}{2}$th of this 41 mm. shell is approximately the same (12 mm.) as that of the assumed $8\frac{1}{2}$th whorl of the giant 60 mm. shell. The latter may therefore be reasonably assumed to have had originally 9, possibly $9\frac{1}{2}$, whorls.

Until connecting sizes are found this 'outsize' shell may be regarded as an example of gigantism.

Recently an even larger shell has come to hand, collected by Dr. L. Kent (Geological Survey) somewhere between Port Shepstone and Durban. It measures 65 × 26 mm.; only $4\frac{1}{2}$ whorls remain, the $3\frac{1}{2}$ or $4\frac{1}{2}$ apical whorls being missing. The callus on the last two whorls occupies one half of the preceding whorl.

Bullia mozambicensis Smith

Figs. 25(*d*), 27(*i*), 28

1877. Smith. *Proc. Zool. Soc. Lond.*, p. 719, pl. 75, fig. 18 (not good).
1894. Sowerby. *J. Conch.*, vii, p. 368 (*pustulosa*).
1897. id. *Append. Mar. Sh. S. Afr.*, p. 5, pl. 6, fig. 1 (*pustulosa*).
1931. Tomlin. *Ann. Natal Mus.*, vi, p. 430.

Aperture $1\frac{1}{4}$ ($-1\frac{1}{3}$) in spire. Diameter of protoconch 0·5, of 1st whorl 0·75, of 2nd 1·5, and of 3rd 1·75 mm. Whorls (total) 9. Profile straight, slightly concave near apex. Parietal callus thin, very narrow on 4th whorl, on 5th extending up $\frac{1}{4}$–$\frac{1}{3}$ length of preceding whorl, on 6th–9th whorls up to $\frac{1}{2}$ or nearly $\frac{1}{2}$, never exceeding $\frac{1}{2}$. First three whorls smooth; close-set regular slightly curved axial plicae on 4th and following whorls, from suture to suture on early whorls, but on (7th) 8th and 9th becoming obsolete on middle and lower part of whorl, forming a strong crenulation at the suture, *c.* 22 on 4th, 30–32 on 5th and later whorls, but becoming irregular and more or less coalescent on 8th and 9th whorls. Spiral striae 8–9 on 4th and following whorls, 9–10 on 9th whorl, deep, cutting the axial plicae into conspicuous pustules on 4th–7th whorls (not well shown in Smith's figure), but on 8th the pustules are flattened and the sculpture consequently only cancellate, middle and lower part of 9th whorl with only spiral striae; 4–5 additional striae on base; the pustules and striae on the lower part of the whorls not completely concealed by the callus. Columella with a somewhat pronounced bend at the anterior canal; glaze thin, covering not more than $\frac{1}{3}$ of base. 43 × 18 mm.

Operculum not filling aperture, ovate, apex incurved, margins smooth, 6·5 × 3 mm. in 31 mm. shell with 13 mm. aperture.

Cream or flesh-coloured, sometimes slightly livid on middle of whorls, aperture orange within but pale at margin of outer lip, operculum amber.

Foot with antero-lateral corners shortly pointed, posteriorly with 2 tails, no eyes. Radula with 80 rows, central plate $1\frac{1}{3}$–$1\frac{1}{2}$ times as wide as lateral plate, its base about 4 times as wide as long, with 11–12 (13) cusps, lateral

plate with inner cusp bifurcate, outer prong more slender than inner prong.

Animal pale greyish-buff.

Dead: Quelimane (Smith); Durban (Sowerby); Durban and Tongaat (S. Afr. Mus.); mouth of Limpopo Ruver (Chai Chai, Portuguese East Africa) (S. Afr. Mus. coll. Ross-Frames).

Living: Chinde, mouth of Zambesi River (S. Afr. Mus. coll. K.H.B.).

Remarks. The differences between this species and *natalensis* have been given above. The length of the first three whorls is here less, and the shape therefore more mamilliform.

Bullia digitalis Meuschen

Figs. 25(*e*), 27(*j*), 29

1787. Meuschen. *Mus. Gevers.*, p. 296.
1816. Lamarck. *Tabl. Encycl. Meth.*, pl. 400, figs. 4 *a*, *b*, and Liste, p. 2 (*Buccinum achatinum*, nom. et fig.).
1846. Reeve. *Conch. Icon.*, iii, Bullia sp. 4, pl. 4 (*digitale*), sp. 14 (*sulcata*), sp. 17 (*semiflammea*).
1847. id. ibid., sp. 22 (*semiusta*).
1885. Euthyme. *Bull. Soc. malac. Fr.*, ii, p. 237 (*capensis*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 53 (*digitata* [*sic*] *et alia*).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 54, pl. 35, fig. 4 (*almo*).
1921. Sowerby. *Proc. Mal. Soc.*, xiv, p. 125, text-fig. (*dulcis*).
1922. Tomlin. *J. Conch.*, xvi, p. 260.
1923. Odhner. *Göteb. K. Vet. Handl.*, xxvi, 7, p. 6.
1932. Turton. *Mar. Sh. Pt. Alfred*, pp. 65, 66, pl. 15 (*digitalis* and vars.).
1932. id. ibid., p. 65, pl. 15, no. 470 (*soluta* Gmelin, subscalariform).
1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 22.
1937. Peile. loc. cit., p. 184 (radula) (*achatina*).

Aperture $1\frac{1}{2}$–$1\frac{2}{3}$ (ocasionally 2) times in spire. Angle of spire 30°–35°. Apical whorl (protoconch) diam. 0·6 mm. Whorls (total) 10. Profile of whole shell straight. Parietal callus thin, visible from 4th whorl, extending up about $\frac{1}{6}$ length of preceding whorl. Spiral striae from 3rd whorl onwards over whole whorl, but often indistinct and obsolescent on middle and lower part of whorls, very fine, close together, minutely crinkly due to intersection with the fine growth-lines; 5–6 additional stronger and widely spaced striae on base. Columellar glaze thin, extending over about half base. 52 × 21 mm., smallest examined 4 × 1·75 mm.

Operculum triangular, both margins strongly serrate, but often worn nearly smooth, apex narrow, concave between two little points, 6 × 3·75 mm. in 45 mm. shell with 16 mm. aperture.

Variously coloured: uniform cream, fawn, brown (*achatina*), sometimes with livery tinge (*sulcata*), plumbeous or violaceous; upper half of whorls cream, lower half brown (*semiusta*); cream with a peripheral series of orange-brown spots which extend downwards (as if the colour had 'run') as axial streaks and flames (*semi-flammea, dulcis*), sometimes the spots are absent and the axial streaks may be separate and distinct, or they may be coalescent into a more or less solid band, thus approaching the *semiusta* pattern; the apex is usually white,

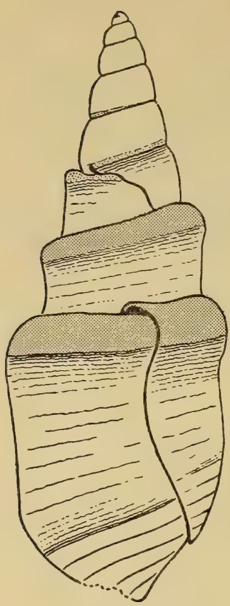


FIG. 29.
Bullia digitalis Meuschen. 14 mm. specimen from Still Bay to show abnormal development of callus after injury, producing an *annulata*-like shoulder. Callus stippled.

even in *achatina*; sometimes the early whorls may be brown with the later ones becoming gradually uniform cream. Operculum amber.

Foot with antero-lateral corners acute, posteriorly with 2 tails, no eyes. Radula with 75–85 rows, central plate about $1\frac{1}{2}$ times wider than lateral plate, its base nearly 4 times as wide as long, with 15–17 cusps, and often a minute denticle externally on one or both sides, lateral plate with inner cusp bifurcate, outer prong smaller than the inner prong.

Animal pale flesh-coloured, foot sometimes plumbeous or violaceous.

Fossil, Quaternary: Angra Junta, South West Africa (Haughton).

Dead: Angra Pequena (Lüderitzbucht), Olifants River mouth, False Bay, Port Elizabeth, Port Alfred (auct). Table Bay, Plettenberg Bay (S. Afr. Mus.). Off Cape Morgan, 36 fathoms (S. Afr. Mus. P.F. coll.).

Living: False Bay, littoral and 9 fathoms, Port Elizabeth, littoral (S. Afr. Mus.); Hydra Bay (Danger Point) (Odhner, presumably living); Saldanha Bay and Lambert's Bay, 15 metres (U.C.T.).

Remarks. The earlier records from Lüderitzbucht might have been open to doubt, but have been confirmed by Tomlin (1922). The Olifants River, Lambert's Bay and Saldanha Bay records connect with Table Bay, but there is a considerable gap between the first mentioned and Lüderitzbucht. The species has not been reported from Port Nolloth. At Lambert's Bay U.C.T. found it at 15 metres depth, but not on shore.

Examples with the *semiflammea-dulcis* colour pattern are liable to be confused with *diluta*, but may be distinguished by the shorter spire relatively to the aperture, and the fine spiral striae.

Subscalariform aberr. (fig. 29). A 14 mm. specimen (Still Bay, coll. Muir) has the first 5 whorls normal, but the following two with well-marked shoulders. Below the shoulder the profile of both whorls is straight, and thus the width of the last whorl (5·5 mm.) is scarcely greater than that of an equal-sized normal example. The 4th and 5th whorls show the peripheral series of spots, but the last 2 whorls are uniform cream.

The change to shouldered whorls was caused by an injury. Instead of the parietal callus being plastered as a thin layer against the preceding whorl, only its edge adjoins the preceding whorl (forming a 'false' suture), the rest of the layer projects outwards forming the shoulder. A later, less severe injury has resulted only in an irregular joint, without further upsetting the animal's organization.

Bullia rhodostoma (Gray MS.) Rve.

Figs. 25(*g*), 27(*k*)

1847. Reeve. *Conch. Icon.*, iii, Bullia no. 25.
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 55 (*polita* ? non Lam.).
1937. Peile. loc. cit., p. 184 (radula).

Aperture $1\frac{1}{3}$–$1\frac{1}{4}$ times longer than spire (juv.), subequal to spire (half-grown), $1\frac{1}{4}$ in spire (fully grown). Angle of spire *c.* 40°. Apical whorl (protoconch) diam. 0·75 mm. Whorls (total) 9. Parietal callus thin, visible from 3rd whorl, extending up $\frac{1}{3}$, sometimes almost $\frac{1}{2}$ length of preceding whorl. Spiral striae from 3rd whorl onwards, over whole whorl on 3rd and 4th but on later whorls confined to upper part, obsolescent on middle and lower parts, even on the upper part rarely more than half-a-dozen very fine striae, often indistinct or obsolete, no additional striae or only very fine and indistinct ones on base (see Remarks); growth-lines may produce a fine minute crinkling at the sutures. Columellar glaze thin, extending at most only halfway across base. 47 × 19 mm., smallest examined 4 × 2·75 mm.

Operculum ovate, apex incurved, margins smooth, 9 × 3·75 mm. in 39 and 41 mm. shells with apertures 17–18 mm.

Cream or flesh-coloured, lower part of whorls sometimes darker, sometimes paler, due to the parietal callus, costa on base orange, aperture deep orange within but paler at margin of outer lip, varices (if present) yellow or orange; operculum amber.

Foot with antero-lateral corners shortly pointed, posteriorly with 2 tails, no eyes. Radula with 55–60 rows (40–45 in 17 mm. shells), central plate only a little wider than lateral plate, its base about 3 times as wide as long, with 11–13 cusps, often a minute denticle externally on one side or the other, lateral plate usually with 2 smaller cusps on the outer margin of its inner cusp, on one side sometimes with only one, sometimes with 3 (cf. Peile).

Animal pale greyish or flesh-coloured.

Dead: Port Elizabeth, Port Alfred (Sowerby, Bartsch, Turton). Pringle Bay (east side of False Bay), and Still Bay (S. Afr. Mus.).

Living: False Bay, littoral; Mossel Bay; Port Elizabeth, littoral; Durban, littoral (S. Afr. Mus.). Delagoa Bay (U.W.).

Remarks. The Durban specimens conform with the above description in all respects, including the animal with its radula, but the spiral striae are more distinct than in the majority of examples from farther west; in one specimen 29 mm. long there are about 20 striae on the upper part of the last (8th) whorl and 8–10 at bottom of base; the largest specimen 33 mm. also with 8 whorls, has fewer striae above but more below, and faint traces of striae in the middle of the whorl.

I have seen only one juvenile from Delagoa Bay, but the radula agrees.

In the Pringle Bay specimens the outer lip at irregular intervals has been thickened to form a varix; in one specimen one varix on penultimate whorl

and about 10 on last whorl, the latest-formed 4–5 close together; in another specimen one varix on penultimate whorl and 4 on last; three others have 1–4 varices on the last whorl only; one other specimen has only one feeble varix near margin of outer lip. Specimens from other localities very rarely produce varices.

The specimen which Bartsch referred to '*polita* Lam.' is probably a *rhodostoma*. (The West African *polita* Lam. = *miran* Brug. is a *Dorsanum*, see Dautzenberg 1910.)

Bullia laevissima (Gmelin)

Figs. 25(*h*), 27(*l*)

1816. Lamarck. *Tabl. Encycl. Meth.*, pl. 400, figs. 1 *a*, *b*, and Liste, p. 2 (*Buccinum laevigatum*, nom. et fig.).
1886. Watson. *Challenger Rep.*, xv, p. 190 (*laevigata*) (references).
1903. Von Martens *D. Tiefsee Exp.*, vii, pp. 29, 53 (*laevigata*).
1922. Tomlin. *J. Conch.*, xvi, p. 260.
1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), pp. 22, 46, pl. 5, fig. 3.
1932. Gevers. ibid., p. 74.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 66, pl. 16, no. 482 (juv.), and var. *globulosa*.
1937. Peile. loc. cit., p. 184, fig. 19 (radula) (*Leiodomus l.*).

Aperture at first subequal to spire, but at an early stage becoming longer than spire, in adult spire $1\frac{1}{2}$ in aperture. Apical whorl (protoconch) diam. 0·75 mm. Whorls (total) 7, perhaps 8, broadening rapidly from 3rd or 4th whorl onwards. Parietal callus thick, intervening between suture and preceding whorl, and extending up about $\frac{1}{3}$ length on 4th whorl (sometimes beginning to show on 3rd), increasing to $\frac{1}{2}$, often to $\frac{2}{3}$ or even $\frac{3}{4}$ length of preceding whorl in large shells. On 2nd whorl a spiral stria at top of whorl, becoming a sulcus on 3rd, rather broad but shallow on 4th and 5th whorls, but narrowing and obsolescent on 6th, on 7th only a slight indentation below the rounded shoulder; 2–3 (sometimes 4) striae on lower part of base in juveniles, but in older examples only the lowermost one persisting, and that one obsolete in very large shells (over 35 mm. long). Columellar glaze thick and extending over whole base. 55 × 34 mm., another with worn apex 57 mm. long; Tryon gives 75 mm.; smallest specimen examined 4·25 × 2·75 mm.

Operculum very small, subtriangular (similar to that of *annulata* but much smaller), or narrow oval or cuneiform, apex truncate, margins smooth, 5 × 4 mm. or 5 × 2 mm. in 42 mm. shells with 25 mm. apertures, and 4·5 × 2·5 mm. in 55 mm. shell with 35 mm. aperture.

Cream, fawn, or greyish, with 2–3 faint spiral darker bands, the band near the suture more visible than the other(s); columella suffused with pink or madder-brown; operculum amber-brown.

Foot with antero-lateral corners very shortly pointed, posteriorly with 2 small tails, no eyes. Radula with *c.* 80 rows, central plate $1\frac{1}{3}$–$1\frac{1}{2}$ times as wide as lateral plate, its base 4–$4\frac{1}{2}$ times as wide as long, with (18) 19–22 cusps, often a minute denticle externally, lateral plate with inner cusp bifurcate,

symmetrical, or the outer prong bifurcate on one side, or bifurcate on one side and trifurcate on the other (cf. Peile).

Animal purplish-brown or livery-pink, edge of foot pale.

Fossil, Quaternary: Bogenfels and Angra Junta, South West Africa (Haughton); Sedgefield near Knysna (Martin); Recent: Cape Cross salt-pan, South West Africa (Gevers).

Dead: Lüderitzbucht, Olifants River mouth, Table Bay, False Bay, Algoa Bay, Port Alfred (auct.).

Living: Simon's Bay (False Bay), 15–20 fathoms (Watson). Saldanha Bay, 10–14 fathoms; Table Bay; False Bay, 10–22 fathoms, Mossel Bay and off Cape St. Blaize, 17–19 fathoms (S. Afr. Mus. P.F. coll.). Lambert's Bay, 15 metres; Saldanha Bay, False Bay and Algoa Bay (U.C.T); 34° S 25° 46′ E., 41 fathoms (U.C.T.).

Remarks. Smith (1903) said *laevigata* Chemn. was not published by a binomial writer, but Watson (1886) quotes '*Buccinum laevigatum*' Chemn. 1780, with full reference, and *laevissima* Gmelin 1790.

This is the only South African species in which the aperture exceeds the spire in length (except in very juvenile).

Juveniles less than 10 mm. in length are not always distinguishable with certainty from those of *annulata*, but are usually proportionately broader and the length of the aperture exceeds that of spire.

Bullia callosa (Gray) Rve.

Fig. 27(*m*)

1828. Gray in Wood. *Suppl. Ind. Test.*, p. 12, pl. 4, fig. 14 (*Buccinum c.*) (*fide* Dautzenberg, 1912. Sherborn, *Ind. Anim.*, says nom. et fig.).
? 1839. Gray. *Zool. of the 'Blossom'*, p. 127 (*semiplicata*).
1847. Reeve. *Conch. Icon.*, iii, Bullia sp. 24.
? 1884. Fischer. *Man. Conchyl.*, p. 636, pl. 5, fig. 4 (*Buccinanops semiplicata* Gray).
1889. Sowerby. *J. Conch.*, vi, p. 6 (var. *sulcata*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 53.
1912. Dautzenberg. *Ann. Inst. ocean.*, vol. v, fasc. 3, p. 34 (*Dorsanum c.*).
1932. Gevers. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 74.

Aperture subequal to spire. Apical whorl (protoconch) diam, 0·75 mm. Whorls (total) 7, turreted (pagoda-like), profile straight, at least on later whorls. Parietal callus thick, often very thick, intervening between suture and preceding whorl, and extending up about $\frac{1}{3}$ length, when strongly developed extending not farther upwards but outwards to form a rounded shoulder above the suture of following whorl. On 3rd whorl a spiral stria at top of whorl (sometimes traceable on later part of 2nd whorl) becoming on 4th and later whorls a sulcus followed by a stria, sometimes 2–3 additional striae traceable but rarely distinct, 4–5 additional ones on base. Columellar glaze thick and extending over whole base. 37 × 19 mm. (worn); Turton: 45 mm. long. Smallest specimen examined 3 × 1·75 mm.

Operculum small, narrow triangularly ovate, margins smooth, $5 \cdot 5 \times 2 \cdot 5$ mm. in 35 mm. shell with 20 mm. aperture.

Brown or purplish-brown, the callus band darker, operculum amber. Beach specimens cream, fawn or pale brown, the callus forming a brown spiral band and a brown patch on base.

Foot with antero-lateral corners shortly pointed, posteriorly with 2 small tails, no eyes. Radula with *c.* 90 rows, central plate $1\frac{1}{2}$ times as wide as lateral plate, its base about $2\frac{1}{2}$ times as wide as long, with 13–15 cusps; lateral plate with inner cusp bifurcate, outer prong more slender than the inner (only one radula available).

Animal purplish-brown, sole darker than upper part of foot.

Fossil, Recent: Cape Cross salt-pan, South West Africa (Gevers).

Dead: Lüderitzbucht, Port Elizabeth, Port Alfred (von Martens, Sowerby, Turton). Still Bay (S. Afr. Mus. coll. Muir); Durban and Tongaat (30 miles N. of Durban) (S. Afr. Mus.).

Living: Mossel Bay and off Cape St. Blaize, 17 fathoms (S. Afr. Mus. P.F. coll.). Algoa Bay (U.C.T.).

Distribution. Mossamedes, 15–20 metres (Dautzenberg).

Remarks. Juveniles 7–8 mm. long (5 whorls) usually, and 5 mm. long (4 whorls) sometimes, are recognizable by the brown callus band; smaller examples in which the callus is as pale as rest of shell are very similar to juveniles of *annulata* but narrower.

The Durban and Tongaat examples—up to 38 mm. long—show the subsutural sulcus and 3–4 striae very clearly (var. *sulcata*), except on the last (7th) whorl of the largest specimen

On the south coast this species has not been recorded from farther west than Still Bay, not even from False Bay. There is therefore a big gap in the distribution until one comes to Lüderitzbucht and Cape Cross on the west coast, and farther north Mossamedes.

Presumably the south and west coast examples are conspecific. Live specimens from the west coast would be useful for comparison, because the South African *callosa* is a true *Bullia*, i.e. without eyes and with two tails, not a *Dorsanum* as defined by Thiele (1929).

Gen. *Adinopsis* Odhner

1923. Odhner. *Göteb. K. Vet. Handl.*, xxvi, 7, p. 15.
1929. Thiele. *Handbuch*, i, p. 740 (addenda).
1937. Peile. *Proc. Mal. Soc.*, xxii, p. 186 (radula).

Shell in general resembling *Bullia*, profile slightly concave, apex blunt, no parietal callus, columellar glaze narrow, outer lip plicate within.

Operculum apex incurved, margins smooth.

Animal with eyes, foot with 2 tails posteriorly. Radula lateral plate with 2 cusps, the inner one not bifurcate.

Adinopsis skoogi Odhner

1923. Odhner. loc. cit., p. 15, pl. 1, figs. 11–14.
1937. Peile. loc. cit., p. 186, fig. 24 (radula).

Length 25 mm. Brown with two pale spiral bands.
Port Alexander, Angola, 16 fathoms.

Fam. *VOLEMIDAE*

1929. Thiele. *Handbuch*, i, p. 319 (*Galeodidae*).
1952. Bayer. *Zool. Med.*, xxxi, no. 25, p. 265.

If *Volema* Bolten-Röding 1798 is admitted as a valid genus, the family name should be *Volemidae*. Bayer pointed out that *Galeodes* Bolten-Röding is preoccupied, and therefore adopted *Melongena*. He included as a section of this genus the earlier *Volema*; it would seem more correct to make *Volema* the genus, with sections *Volema* s.s. and *Melongena*.

Gen. Volema Bolten-Röding

1798. Bolten-Röding. *Mus. Bolten.* (2), p. 57.
1817. Schumacher. *Essai . . . vers testacés*, pp. 64, 212.
1929. Thiele. loc. cit., p. 320 (*Galeodes*, non Olivier, 1791).
1952. Bayer. loc. cit., p. 265 (*Malongena*).

Volema paradisaica (Martini-Reeve)

Fig. 30(*a*), (*b*)

1777. Martini. *Syst. Conch. Cab.*, iii, p. 202, figs. (full reference in Bayer) (*Pyrum p.*).
1790. Gmelin. *Linn. Syst. Nat.*, ed. 13, p. 3484, no. 56 (*Buccinum pyrum*).
1847. Reeve. *Conch. Icon.*, iv, Pyrula, no. 17.
1933. Krige. *Tr. Geol. Soc. S. Afr.*, xxxv (1932), p. 52.
1952. Bayer. loc. cit., p. 276 (*pirum*, [*sic*]).
1952. Braga. *Anais J. Invest. Ultramar.*, vii, 3, p. 73, pl. 2, fig. 4 (*Melongena p.*).

Protoconch 2 whorls, diam. 1·3, alt. 1·5 mm., smooth, with a few feeble plicae before the not sharply defined junction with 1st postnatal whorl; the latter with 10–11 peripheral knobs.

Radula with *c.* 120 rows, central plate longer than wide, anteriorly concave, posteriorly convex, outer cusp as long as basal plate, middle cusp much smaller; lateral plate as wide as length of basal plate of central, outer cusp twice as long.

Fossil, raised beach, alt. 375 ft. at Durban-Umgeni (Geol. Survey).

Durban Bay, Delagoa Bay, Mozambique (auct. *vide* Bayer).

Durban Bay, one with periostracum (S. Afr. Mus.); Inhambane, juv. (U.C.T.).

Living: Delagoa Bay (S. Afr. Mus. coll. K.H.B. and U.W.).

Distribution. Red Sea, Zanzibar, Mombasa, Ceylon, East Indies.

Remarks. Bayer gave references to early descriptions.

Sowerby's record from Port Elizabeth can scarcely be based on even a beach specimen, certainly not a living one; it was transported more probably by a collector than by a marine current.

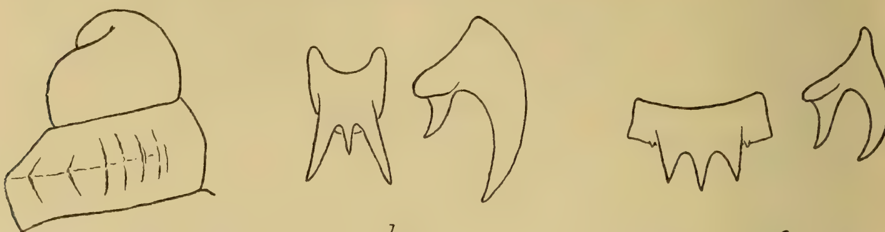


FIG. 30.

(*a*), (*b*) *Volema paradisaica* (Mart. Rve.). Protoconch; central and lateral radula plates. (*c*) *Engina mendicaria* (Linn.) central and lateral radula plates.

Fam. *BUCCINIDAE*

Tomlin (1932) described two species in the genus *Glypteuthria* solely on conchological characters. One of these (*capensis*) has since been shown by the radula to belong to *Fusivoluta*, and the other (*solidissima*) conforms in all essentials with *Afrocominella elongata.* This Antarctic genus, therefore, has no place in the South African fauna-list.

Tomlin (1932) also proposed a new genus *Charitodoron* in this family. One of Tomlin's species is, in my opinion, synonymous with *Columbella agulhasensis* Thiele, which raises the possibility that the genus may be Columbellid, or even Mitrid (see pp. 146 and 51,52).

The P.F. obtained no examples of the genera *Phos. Metula*, or *Pisania*, and these genera are not discussed here.

A most unlikely species to be found on the Natal coast or off the Cape is the New Zealand *Siphonalia mandarinus* (Duclos), recorded by Krauss (1848) and Studer (1889). The *Gazelle* specimens from off the Cape were probably *Fusivoluta* (see p. 30); and Krauss's specimens probably a *Fasciolaria* (see p. 77).

'Cominella' species. The following species are transferred to Muricid genera: *acutispira* Sow., *fuscopicta* Turton, *puncturata* Sow., *unifasciata* Sow., *wahlbergi* Krss.; *sulcata* Sow. has been transferred to *Daphnella*, and *angusta* Sow. might well be compared with *Mangilia ponsonbyi* (*Turritidae*).

Gen. CHARITODORON Tomlin

1932. Tomlin. *Ann. S. Afr. Mus.*, xxx, p. 164.
1943. id. *J. Conch.*, xxii, p. 50.

Shell fusiform, thin-walled, aperture shorter than spire, whorls with spiral grooves or striae, axial ribs present on early whorls, sometimes feeble, or

entirely absent; no parietal callus, columella straight, canal short and broad, outer lip thin, internally smooth; periostracum thin. Operculum and animal unknown.

Remarks. This genus has been found not only off the Cape, but also in deep water off East London; its occurrence in deep water off the Natal coast, therefore, would not be very surprising. In fact one shell, at first thought to be a *Charitodoron*, was recently found while searching through the P.F. bottom-samples.

This 4-whorled shell would have been referred to *C. pasithea* in spite of the remoteness of Natal from the type locality of this species, because of its close similarity in measurements with the upper 4 whorls in Tomlin's figure (which is × 2) and its agreement with his description. Fortunately, however, the shell contained the animal, and the radula showed it to be a Mitrid (see *supra*, *Dibaphus*, p. 51).

The remoteness of the two localities thus seems, conversely, to override the conchological similarities, and to be a positive reason for not identifying the Natal shell with *C. pasithea*. At least, until a radula is obtained from an undoubted species of *Charitodoron*, it is safer to leave this genus where Tomlin placed it. Quite possibly it may eventually be removed to the *Columbellidae* in which Thiele described his *agulhasensis* (syn. *aglaia* Tomlin, see p. 146).

Key to species

1. Early whorls cancellate.
   - *a.* Later whorls punctate-striate . . . . *euphrosyne*
   - *b.* Later whorls smooth . . . . *agulhasensis*
   - *c.* With deep spiral grooves, cancellate sculpture on last whorl feeble . *pasithea*
2. All whorls with spiral striae only . . . . *thalia*

Charitodoron euphrosyne Tomlin

1932. Tomlin. loc. cit., p. 167, fig. 8.

Protoconch $2\frac{1}{2}$ whorls, diam. 1, alt. 1·25 mm., smooth. Postnatal whorls 6; (1st corroded) 2nd and 3rd cancellate with axial ribs and spiral lirae, the former gradually petering out on 4th whorl, 5th and 6th whorls with punctate striae only, on 2nd and 3rd whorls 6–7 striae, on 4th 7–9, on 6th 8–10, on base 10–12 (excl. those on rostrum), additional stronger striae becoming deeper and broader grooves. 30 (protoconch missing) × 10 mm.

White with pale yellowish periostracum.

S.W. of Cape Point, 660–700 fathoms (Tomlin); off west coast of Cape Peninsula and south-west of Cape Point, 130-210 fathoms, all dead (S. Afr. Mus. P.F. coll.).

Type in S. Afr. Museum.

Remarks. Only one specimen has a complete protoconch; and in all the specimens corrosion has affected the 1st, and often the 2nd and partly the 3rd whorl. The protoconch appears to have been smooth.

Charitodoron agulhasensis (Thiele)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 173, pl. 30 (18), fig. 20 (*Columbella a.*).
1932. Tomlin. loc. cit., p. 169, fig. 9 (*aglaia*).

Protoconch 2½ whorls, diam. 1 mm., smooth. Postnatal whorls 7 (6 in Type of *aglaia*); 1st and 2nd whorls cancellate with numerous axial ribs and 6 spiral striae; 3rd (and sometimes part of 4th) obscurely punctate-striate; later whorls smooth except for the fine slightly arcuate growth-lines, in some lights 4–6 extremely faint spiral lirae may be visible; base with about 12 (excl. those on rostrum) additional grooves. Type (*aglaia*): 26 × 9 mm., 31 × 10 mm. Type (*agulhasensis*): 17 × 5 mm.

White with pale yellowish periostracum, with indications here and there of slightly darker axial flames.

35° 16′ S. 22° 26′ E., 155 metres (Thiele); exact locality ? (Tomlin). Cape St. Blaize N. × E. distant 73 miles, 125 fathoms; 36° 40′ S. 21° 26′ E., 200 fathoms; off Cove Rock (East London area), 80–130 fathoms; all dead (S. Afr. Mus. P.F. coll.).

Type of *aglaia* in S. Afr. Museum.

Remarks. Tomlin's description says there are 9 whorls, but the Type has only 8 (total), the tip of the protoconch being worn away.

There are three smaller specimens in S. Afr. Mus. from the same haul as the Type. As in *euphrosyne* the apices are corroded.

The Cape St. Blaize specimen is larger than the Type, but is badly corroded, only the apex and body whorl and connecting columella remaining. Protoconch 2½ whorls plus 7 whorls. Periostracum greyish-brown. Six smaller specimens were taken in the same haul.

The Cove Rock specimen, entered in the Museum Register, seems to be missing from the collection.

It is a pity to have to displace Tomlin's specific name, but the synonymy seems clear; a 19 mm. specimen in S. Afr. Mus. corresponds exactly with Thiele's description and figure.

Charitodoron pasithea Tomlin

1943. Tomlin. loc. cit., p. 50, fig.

Protoconch eroded, about 7 postnatal whorls; deep regular spiral grooves, 8 on penultimate whorl, slight arcuate axial ribs on upper whorls, hardly traceable on body whorl. 21 × 8 mm.

Off Cape Point, 430–630 fathoms (Tomlin); same locality, down to 800 fathoms, all dead (S. Afr. Mus. P.F. coll.).

Remarks. Tomlin said all the specimens were in one way or another broken and mended; the figure shows a varix where the shell has been mended.

The above description is abstracted from Tomlin. None of the four registered specimens (Tomlin said: 'several') are in S. Afr. Museum; they are either still in the Tomlin collection, or were lost in transit during the war.

Charitodoron thalia Tomlin

1932. Tomlin. loc. cit., p. 169, fig. 10.

Protoconch $2\frac{1}{2}$ whorls, diam. 1·3 mm., smooth (but worn). Postnatal whorls 5; whorls slightly shouldered (more so in the second specimen than in the Type) immediately below the impressed suture; fine growth-lines, spiral (non-punctate) striae on all whorls, 9 on early whorls increasing to 10–12 on body whorl, *c.* 16 (*c.* 20 incl. those on rostrum) additional stronger grooves on base. 21×8 mm.

White with pale cream periostracum.

Off Cape Point, 131 fathoms (Tomlin); off Cape Point, 800-900 fathoms; off Buffalo River (East London area), 310 fathoms; all dead (S. Afr. Mus. P.F. coll.).

Type in S. Afr. Museum.

Remarks. A relatively broader species than either *euphrosyne* or *agulhasensis*.

Although the tip of the protoconch is worn smooth in both examples, I find only 5 postnatal whorls. The protoconch is obviously larger than in *euphrosyne* and *agulhasensis*.

The smaller specimen (not seen by Tomlin) has a small but distinct square shoulder below the suture.

The East London specimen, entered in the Museum Register, seems to be missing from the collection.

Gen. Babylonia Schl.

1822. Lamarck (*Eburna*, non Lamarck, 1801).
1838. Schlüter. *Kurzg. syst. Verz. Conch.*, p. 18.
1929. Thiele. *Handbuch*, i, p. 312 (fig. 344 radula).
1929. id. ibid., p. 332 (*Zemiropsis, Olividae*).
1937. Peile. *Proc. Mal. Soc.*, xxii, p. 182 (systematic position).
1953. Kubo & Kondo. *J. Tokyo Univ. Fish.*, xxxix, p. 199, fig. 2 B (age determination based on operculum).
1957. Yoshihara. ibid., xliii, p. 207, pl. 7, figs, C, D (spawning and egg-capsule).

Remarks. Thiele in making a new genus (in the *Olividae*!) for the South African species, evidently had not seen or had overlooked Sowerby's 1902 record and figure. Even without recourse to the radula the species is obviously a *Babylonia*, to which genus Peile restored it.

Babylonia papillaris (Sow.)

Fig. 31(*a*)

1825. Sowerby. *Cat. Tankerville Coll.*, Append., p. xxii (*Eburna p.*).
1833. id. *Conch. Illustr.*, Pt. 20, Eburna, no. 9, fig. (*Eburna p.*).

1902. id. (3rd). *Mar. Invest. S. Afr.*, ii, p. 93, pl. 2, fig. 3 (*Eburna p.*) (shell and animal, operculum badly drawn).
1929. Thiele. loc. cit., p. 332 (*Zemiropsis p.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 31 (*Eburna p.*) and p. 31, pl. 6, no. 229 (*millepunctata*).
1937. Peile. loc. cit., p. 182, fig. 15 (radula).

Protoconch $1\frac{1}{2}$ whorls, diam. at apex 1·5–2 mm., increasing to 2·5–3 mm. Postnatal whorls 5. 47 (to end of columella) 50 (to base of aperture) × 27 mm. Smallest specimen seen 10 mm. long.

Operculum elliptical, concave, nucleus apical, 16 × 7 mm. in 38 mm. shell.

White with reddish or orange-brown spots, varying from moderately numerous (1–2 mm. diam.) to very numerous (0·5 mm. or less) (*millepunctata*); sometimes larger spots near the suture and around base, and forming a central band, small spots on rest of whorl; the large spots near suture usually larger than others and oblique, flame-like; operculum yellowish-amber. Periostracum yellowish.

Animal (as preserved) flesh-coloured; possibly orange when alive.

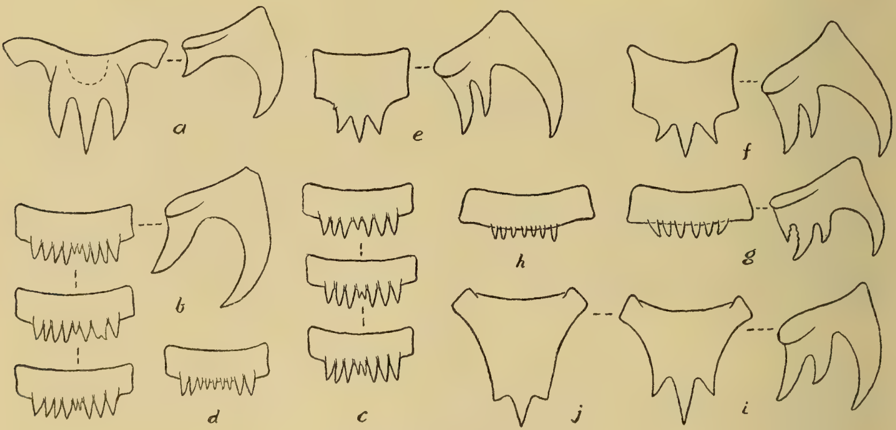


FIG. 31.

Central and lateral radula plates of (*a*) *Babylonia papillaris* (Sow.); (*b*) *Nassaria gracilis* Sow., central plates from front, middle and hind portions of radula; (*c*) the same, from another animal; (*d*) central plate of a Delagoa Bay specimen; (*e*) *Afrocominella capensis* (Dnkr.); (*f*) *A. elongata* (Dnkr.); (*g*) *Burnupena cincta* (Bolten); (*h*) *B. lagenaria* (Lam.), central plate only; (*i*), (*j*) *Euthria queketti* Smith, with malformation of the 77th (from the front) central plate.

Radula with 30 rows (Peile: 36 rows), central and lateral plates as in Thiele's and Peile's figures, middle cusp on central plate a little longer than the others.

Living: Algoa Bay, 24 fathoms (Sowerby, 1902). St. Sebastian Bay, 27 fathoms; Algoa Bay, 10–36 fathoms; off East London, 22–52 fathoms; off Port Shepstone (Natal), 36 fathoms (S. Afr. Mus. P.F. coll.). False Bay (U.C.T.). 34° 01′ S. 25° 45′ E., 25 fathoms (*millepunctata*) (U.C.T.).

Dead: Natal (Smith); Port Alfred (Bartsch, Turton).

Remarks. The type of this species was in the Tankerville collection (now ?); when describing it Sowerby recorded a second specimen then in Broderip's possession (now Brit. Mus.), formerly in the 'African Museum' (Bullock's). Mr. Galbraith of the British Museum informs me that there are two specimens in the B.M., one of which may be a syntype.

Gen. ENGINA Gray

1839. Gray. *Zool. of the 'Blossom'*, p. 112.
1840. Swainson. *Treat. Malac.*, clii, p. 313 (*Pusiostoma* part).
1939. Peile. *Proc. Mal. Soc.*, xxiii, p. 271 (radula).

Engina perlata (Küster)

1858. Küster. *Conch. Cab.*, p. 61, pl. 12, figs. 5, 6.
1895. Melvill. *Proc. Mal. Soc.*, i, p. 226, pl. 14, fig. 12 (*natalensis*).

Radula as in *mendicaria*, but the external denticles on the central plate are minute or obsolete; *c.* 98 rows.

Living: Durban and Umhlanga (U.C.T.).

Dead: Natal (Küster); Durban (Melvill); Tongaat and Scottburgh (Natal), and Port St. Johns (S. Afr. Mus.).

Engina (*Pusiostoma*) *mendicaria* (Linn.)

Fig. 30(*c*)

1758. Linne. *Syst. Nat.*, ed. 10, p. 731 (*Voluta m.*).
1859. Chenu. *Man. Conchyl.*, i, fig. 1106 (*Columbella m.*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 97 (references).
1911. Schepman. *Siboga Exp. monogr.*, xlix, p. 309, pl. 24, fig. 3 (radula).

Radula with *c.* 100 rows, central plate with 3 subequal major cusps, and a small cusp externally on each side, lateral plate with outer cusp considerably larger than the inner.

Living: Kosi Bay (U.C.T.); Delagoa Bay (U.W.); Mozambique Island (S. Afr. Mus. coll. K.H.B., and U.W.).

Distribution. Mauritius, Seychelles, Madagascar; Indo-Pacific.

Engina marmorata (Rve.)

1846. Reeve. *Conch. Icon.*, pl. 12, fig. 95 (*Buccinum m.*).
1848. Krauss. *Südafrik. Moll.*, p. 120 (*Buccinum m.*).
1880. Von Martens. *Mauritius & Seychellen*, p. 239 (*Pisania m.*).
1939. Peile. *Proc. Mal. Soc.*, xxiii, p. 271, fig. 39 (radula).

Protoconch ? Postnatal whorls 7; axial ribs 10 on 1st whorl, increasing to 18 on penultimate whorl and becoming feeble and obsolete on later part of body whorl; crossed by spiral lirae 3 on 1st whorl, increasing to 8–9 on last whorl, with one very fine intermediary between some of the pairs, *c.* 12 additional lirae on base with intermediaries. Parietal callus dentiform,

columella anteriorly keeled, outer lip internally plicate. 23 (protoconch missing) × 10 mm.

White, variegated with indefinite yellowish and brown patches.

Radula with up to 114 rows, central plate with 3 major and 2 minor cusps, lateral plate with 2 cusps (Peile).

Natal (Krauss, and S. Afr. Mus.); Port Elizabeth and Natal (Sowerby).

Distribution. Mauritius, Seychelles, Philippine Islands.

Remarks. Peile shows that this species cannot be included in *Pisania* or *Cantharus* on account of its radula, which resembles that of *Engina*. He transfers it to *Engina* with a query.

Gen. CANTHARUS Bolten-Röding

1798. Bolten-Röding. *Mus. Bolten* (2), p. 132.
1834. Gray in Sowerby. *Gen. Sh.*, no. 42 (*Pollia*).
1840. Swainson. *Treat. Malac.*, lxxiv, p. 302 (*Tritonidea*).

Cantharus carinifera (Küster)

1858. Küster. *Conch. Cab.*, p. 63, pl. 12, figs. 9, 10.
1901. Smith. *J. Conch.*, x, p. 111, pl. 1, fig. 23 (*natalensis*).
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 229 (*natalensis*).

Aperture longer than spire. Protoconch 2 whorls, diam 1·3 mm., smooth. Postnatal whorls 5; axial ribs on first 2, sometimes 3 whorls 10, sometimes 11 on 3rd, then petering out though occasionally visible on 4th whorl; spiral lirae 4 on each whorl, strong on 4th and 5th whorls, with fine intermediaries on later whorls, on base 8 additional lirae, with intermediaries; parietal callus dentiform, columella keeled anteriorly, outer lip plicate within, the uppermost plica largest and dentiform. 22 × 12 mm.

Orange, with faint white peripheral band. Remains of brown fibrous periostracum in the spiral grooves.

Living: Umtwalumi and Port Edward (Natal) (U.C.T.).

Dead: off Tugela River (Zululand), 14 fathoms, 1 dead but fresh (Sowerby) the specimen referred to by Sowerby without locality) (S. Afr. Mus. P.F. coll.).

Remarks. From the description one suspects that Krauss's *rubiginosus* var. *subcostata* (1848, Südafr. Moll., p. 120; quoted in Sowerby. *Mar. Sh. S. Afr.*, p. 4, as 'scabricostata') was really *carinifera*.

C. undosus (Linn.), very similar with strong spiral lirae, has also been recorded (Sowerby 1889, 1892) as var. *minor* from Port Elizabeth. The locality is suspect.

Cantharus fumosus (Dillwyn)

1817. Dillwyn. *Catal. Sh.*, p. 629 (*Buccinum f.*).
1846. Reeve. *Conch. Icon.*, iii, no. 51 (*Buccinum proteus*).

1859. Chenu. *Man. Conchyl.*, i, fig. 622 (*Buccinum proteus*).
1880. Von Martens. *Mauritius & Seychellen*, p. 239 (*Pisania f.*).
1911. Schepman. *Siboga Exp. monogr.*, xlix, p. 303.
1957. Robertson. *Not. Nat. Philad.*, 300, figs. 5 (shell), 17 (radula).

A dead but fresh Delagoa Bay specimen was collected by U.W. Postnatal whorls 5; 10 broad and rounded axial ribs on each whorl, but not extending across base on body whorl; crossed by spiral lirae 4 on each of the early whorls, 5 on body whorl, rather sharp, with finer intermediaries, 7 additional main lirae on base, with intermediaries; growth-lines distinct. No parietal callus (but columella glaze not fully developed), columella keeled anteriorly, outer lip plicate within. 23 (protoconch missing) × 13 mm. Uniform grey.

Distribution. Mauritius, Seychelles, Madagascar, East Indies.

Remarks. This specimen corresponds well with Chenu's figure.

Cantharus insculpta (Sow.)

1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 2, pl. 1, fig. 4 (*Tritonidea i.*).

Aperture a little longer than spire. Postnatal whorls 5 (Sowerby); axial ribs 12 on 3rd whorl, 14 on last whorl; crossed by spiral lirae 4 on 3rd whorl, 6–7 on last, 10–11 additional lirae on base; spaces between ribs and lirae rather deeply pitted on upper whorls, sculpture almost cancellate. Parietal callus dentiform, columella keeled anteriorly, outer lip smooth within. 11·5 × 6 mm. (Sowerby).

Yellowish-brown with white peripheral band (at or slightly above the actual periphery).

Dead: Port Alfred and Kowie (Sowerby, Bartsch, Turton, and S. Afr. Mus.).

Remarks. I have seen only beach-worn specimens lacking the protoconch.

Gen. Nassaria Link

1807. Link. *Beschr. Nat. Samml. Univ. Rostock* (3), p. 123.
1853. H. & A. Adams. *Gen. Rec. Moll.*, i, p. 123 (*Hindsia*).
1916. Iredale. *Proc. Mal. Soc.*, xii, p. 82 (*Hindsia* H. & A. Adams, 1850 [*sic*]).
1929. Thiele. *Handbuch*, i, p. 310.

Remarks. Iredale's argument for adopting *Hindsia* is not very conclusive; and *Nassaria* is not to be rejected on account of the earlier *Nassarius* (Rule Zool. Nomencl. Art. 36 Rec.).

Nassaria gracilis Sow.

Fig. 31(*b*), (*c*), (*d*)

1902. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 94, pl. 2, fig. 10.
1929. Dautzenberg. *Faune Col. Franc.*, iii, 4, p. 407.

Protoconch 1½ (2) whorls, diam. and alt. 0·75 mm., smooth and polished. Postnatal whorls 8½; first half whorl with 6–8 axial ribs, 9–10 on the following

whorl, increasing to (13) 14 on last whorl, fine growth-lines in the intervening grooves; crossed by spiral lirae 2 on first two whorls, a third lira appearing definitely on 3rd whorl but always less prominent than the other two, intermediaries developed from 4th whorl onwards, *c.* 10 additional lirae on base, with intermediaries; small complanate nodules at the intersections with the ribs. Parietal callus dentiform, columella angularly bent, canal narrow and curved, outer lip plicate within. Periostracum very thin. 29 (protoconch missing) × 15 mm.

Operculum broadly oval, rather thick and lamellate around margin, nucleus apical, 5 × 3·5 mm. in 31 mm. shell.

White with pale brown periostracum.

Radula with 75–85 rows, central plate with slightly concave front margin, 8 cusps (6 in another specimen), with 1–2 smaller ones in the middle, the number of small median cusps varies in different parts of the same radula; lateral plate bicuspid, outer cusp the larger. A Delagoa Bay specimen (fig. 31(*d*)) with 85 rows has a total of 9 cusps on the central plate, 5 shorter and narrower ones flanked on either side by 2 larger and broader ones.

Living: off Tugela River (Zululand), 40 fathoms (Sowerby); off Tugela River and Amatikulu River, 12–26 fathoms (S. Afr. Mus. P.F. coll.). Delagoa Bay (U.W.); 30° 47′ S. 30° 29′ E., 24 fathoms, and 33° 37′ S. 26° 56′ E., 46 metres (U.C.T.).

Distribution. Madagascar (Dautzenberg).

Remarks. The last rib in shells which appear to be fully adult is larger than the preceding ones and forms a varix on the outer lip; sometimes a varicoid rib is developed on one of the previous whorls, the following ribs being normal; smallest such shell seen: 20 mm. long.

N. acuminata Rve. has been recorded from Durban (1897. Sowerby. *Appen. Mar. Sh. S. Afr.*, p. 6), and differs (1902. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 95) in being larger, proportionately broader, fewer axial ribs, closer and less conspicuous spiral lirae.

The Delagoa Bay specimens, largest 29 × 16·5 mm., are relatively broader, but have the same number of axial ribs. The width of course varies according to whether the shell has reached a stage at which a varicoid outer lip is developed.

Dautzenberg said the Madagascan example agreed perfectly with a cotype from mouth of Tugela River, 40 fathoms, in his collection, which came from the MacAndrew collection. One wonders how a *Pieter Faure* shell found its way into the MacAndrew collection!

N. gracilis should be compared also with the Indian *nivea* (Gmelin) 1790 and *suturalis* Adams.

Genus AFROCOMINELLA Iredale

1917. Cooke. *Proc. Mal. Soc.*, xii, p. 227 (radula) (*Cominella* s.l.).
1918. Iredale. ibid., xiii, p. 34, line 22.

1926. Tomlin. *Ann. Natal Mus.*, v, p. 290.
1929. Thiele. *Handbuch*, i, p. 315 (as a section of *Burnupena*).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 98 (radula).
1944. Stephenson. *Ann. Natal Mus.*, x, p. 344 (*Cominella*, list of species).
1947. id. ibid., xi, pp. 271–4 ('Cominella', distribution and notes on species).
1956. Orr. *Proc. Ac. Nat. Sci. Philad.*, cviii, pp. 249 and 251 (differences from *Burnupena*, species not discussed).

Oval-fusiform, spire usually high. Subsutural groove more or less distinct. Canal moderate. Fasciole absent. Early whorls with clathrate sculpture formed by spiral lirae and a *few* (11–12 on first whorl) axial ribs.

Penis without apical prong. Radula central plate as long as broad, with 3 cusps, lateral plate with strong outer cusp, and bifid inner cusp.

Genotype: *elongata* (Dnkr.).

Remarks. Thiele united both Iredale's genera, but he should not have subordinated *Afrocominella*, which has line precedence, to *Burnupena*.

The retention of two genera depends largely on the value attached to the differences in the radulae. In adults the two radula are clearly distinct, but in juvenile *Burnupena* the central plate may be not so broad as in the adult, approximating to the squarish shape found in *Afrocominella* (Peile, 1938, p. 98, fig. 33; Orr, 1956, p. 261). The lateral plates, however, always serve to differentiate the two genera. The sculpture of the early whorls seems to provide an additional distinction.

The two genera are here accepted. Miss Orr has come to the same conclusion.

Afrocominella contains three species (but not *puncturata* Sow. which is a Muricid), which may be distinguished as follows:

1. Axial ribs extending from suture to suture on early and later whorls, but often feeble on the latter.
   a. 7–9 costae on base of last whorl. Only spiral lirae in the subsutural groove (at most one weak costa) . . . . *elongata*
   b. 12–15 costae on base. In the subsutural groove 1–3 well-marked costae *capensis*
2. Axial ribs on later whorls confined to the periphery, forming shoulder knobs *turtoni*

The differences between *elongata* and *capensis* are very slight and both are so variable that it is doubtful whether two species can be maintained; *capensis* has priority.

Afrocominella elongata (Dnkr.)

Fig. 31(*f*)

1857. Dunker. *Proc. Zool. Soc. Lond.* (for 1856), p. 356 (*Cominella e.*).
1899. Smith. *J. Conch.*, ix, p. 248, pl. 5, fig. 3 (*Cominella prolongata*).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 48, pl. 3, fig. 7 (*C. alfredensis*).
1917. Cooke. loc. cit., p. 229, fig. 11 (radula) (*Cominella e.*), and fig. 12 (err.: as *tigrina*), and p. 234, fig. 7 (radula, err.: as 'Euthria queketti).
1918. Iredale. ibid., xiii, p. 34.
1932. Tomlin. *Ann. S. Afr. Mus.*, xxx, p. 166, fig. 7 (*Glypteuthria solidissima*).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 98, fig. 34 (radula).
1938. Eyre and others. *Ann. Natal Mus.*, ix, pp. 96, 109 (*Cominella e.*).

1939. Eyre. ibid., ix, p. 304 (*Cominella e.*).
1947. Stephenson. ibid., xi, pp. 271–3 (distribution) (*Cominella e.*).
1952. Day and others. *Tr. Roy. Soc. S. Afr.*, xxxiii, p. 410.
1956. Orr. loc. cit., text-fig. 1 *i* (radula).

Aperture subequal to spire in juveniles, a little less in larger specimens. Protoconch 2½ whorls, diam. and alt. 1 mm., smooth. Postnatal whorls 9, whorls with distinct shoulder, spire more or less turreted, especially in early whorls; 11–12 axial ribs on 1st whorl, increasing to 15–16 (18) on 6th and 7th whorls, thereafter usually becoming irregular and indistinct, sometimes becoming obsolete from 5th onwards; crossed by 4 spiral lirae on 1st and 2nd whorls, the lowest (most anterior) being the strongest, on 3rd and following whorls the 2 or 3 peripheral lirae are the strongest, being almost costae; from 3rd whorl (at which stage the subsutural groove develops) onwards spiral striae between the lirae-costae, and especially in the subsutural groove (about 15 between suture and shoulder in later whorls); intersections subnodulose; 7–9 additional costae on base, upper ones more or less subnodulose, with intervening striae. Growth-lines (on all whorls) produce a minutely decussate or beaded appearance. Parietal callus dentiform; outer lip indented posteriorly (but not strongly), internally plicate.

61 (protoconch and whorls 1–3 missing) × 24 mm.; 55 (apex missing) × 25 mm.

Operculum oval, scarcely unguiform, 15 × 7 mm. in 52 mm. shell with aperture 27 mm.

Whitish with irregular chestnut or reddish-brown patches, spots and flames; periostracum brown; operculum brown. One specimen (Gr. Fish River, living) without any markings, periostracum grey-brown. Animal speckled with black or dark grey.

Radula with 90–115 rows, central plate about as long (incl. cusps) as wide (base 1½ as wide as long), with 3 cusps, lateral with bifid inner cusp, inner margin of inner prong feebly and obscurely serrulate. Variations: 4 cusps on central, a triple inner cusp on lateral on one side for part of radula (see Peile).

Living: South coast from False Bay to Qolora north of East London (Stephenson 1947); in addition: off Great Fish River, 22 fathoms (S. Afr. Mus. P.F. coll.). 33° 37′ S. 26° 56′ E., 46 metres (U.C.T.).

Stephenson (1947) recorded it also from Oudekraal on west coast of Cape Peninsula, but I have seen these specimens and consider them to be *capensis*.

Off Cape Point (mouth of False Bay) 45 fathoms (Tomlin: *G. solidissima*).

Remarks. Sometimes there are three subequal peripheral costae on the later whorls.

C. prolongata seems to be merely the full-grown *elongata* as shown by the series in S. Afr. Museum.

Two specimens each of *elongata* and *alfredensis* from Port Alfred, collected and presented by Turton, show no *differential characters*.

The identity of *G. solidissima* with *A. elongata* becomes quite clear when the details of the sculpture are compared. It might also be compared with the thick-walled varieties of *capensis* (p. 156), but only one, perhaps two, of the spirals in the subsutural groove are strong enough to be called costae.

In this case specimens of *elongata* in various stages of abrasion were found useful because the *solidissima* shell is slightly corroded in places.

Trophon acutispira (Sow.) is very like juvenile *elongata* of about the same size, but has fewer costae on the base.

Afrocominella capensis (Dnkr.)

Fig. 31(*e*)

1844. Dunker in Phillipi. *Abb.*, 1, p. 110, pl. 1, fig. 7 (*Fusus capensis*).
1852. Petit. *J. Conchyl.*, iii, p. 164, pl. 7, fig. 7 (*Fusus simonianus*).
1860. Gould. *Proc. Boston Soc., Nat. Hist.*, vii, p. 327 (*Euthrya lacertina*).
1874. Von Martens. *J. B. Deutsch. Malak. Ges.*, i, p. 133, pl. 6, fig. 2 (*Euthria lacertina*) (quotes Gould's description verbatim).
? 1877. Velain. *Arch. Zool. Exp. Gen.*, vi, p. 104, pl. 2, figs. 8–11 (*Euthria magellani*).
1903. Smith. *Proc. Mal. Soc.*, V, p. 371 (*Euthria c.* and *lacertina*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 25 (*Euthria c.*).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 180, pl. 32 (20), fig. 3 (*Pisania costata*).
1938. Bright. *Tr. Roy. Soc. S. Afr.*, xxvi, p. 58 (*Pollia lacertina*).
1939. Peile. *Proc. Mal. Soc.*, xxiii, p. 271 (radula) (*E. lacertina*).
1947. Stephenson. *Ann. Natal Mus.*, xi, pp. 271–3 (*Cominella lacertina*).

Aperture a little larger than spire. Protoconch $2\frac{1}{2}$ whorls, diam. and alt. 1 mm., smooth. Postnatal whorls 6–7; whorls gently convex, profile of spire nearly straight, subsutural groove feeble; 11 (12) ribs on 1st whorl, increasing to 13–14 on 5th, thereafter becoming irregular and indistinct; crossed by 4 spiral lirae on 1st and 2nd whorls, 5 on 3rd, lirae becoming costae on later whorls and increasing in number to 10–12 on last whorl, with 12–15 additional ones on base; on last whorl costae all approximately of equal strength, but often a lira between each pair of costae; 1–3 *costae* in subsutural groove; the spiral sculpture is usually very regular and clear-cut, with rather deep sulci between the costae, the sulci striate with closely packed growth-lines. Parietal callus feeble; outer lip feebly indented posteriorly, internally plicate. 32 (protoconch missing) × 15 mm.

Operculum almost regularly oval, apex scarcely, if at all incurved, 8 × 4 mm. in 28 mm. shell.

White or greyish with fulvous or chestnut brown spots and axial streaks and flames, aperture more or less suffused; periostracum greyish-brown; operculum amber brown. Animal dark grey.

Radula with *c.* 90 (juv.) to 110 rows, central plate about as long (including cusps) as broad, base $1\frac{1}{2}$ as wide as long, tricuspid, sometimes with a minute extra denticle on one side, lateral with bifid inner cusp, inner margin of inner prong obscurely serrulate.

Living: Port Nolloth to Cape Agulhas (Stephenson); east and west coasts of Cape Peninsula (S. Afr. Mus.).

Cape Agulhas (Petit: *simonianus*).*

The records (dead shells) from Port Elizabeth (Sowerby), Port Alfred (Turton), and Natal (Sowerby) need confirmation.

Remarks. A slender specimen, 44 × 18 mm. (S. Afr. Mus. no. 4709) locality unknown, but probably Cape, was identified by J. H. Ponsonby as *magellani*, which Smith (1903) thought might be also synonymous with *capensis*.

Three dead specimens from Green Point (Cape Town) (S. Afr. Mus. no. 5518), 20 × 11, 24 × 11 and 25 × 14 mm., white with traces of brown flames: the smallest is slightly thicker-walled and weighs the same as the 24 mm. specimen; the largest is plumper and thicker-walled.

Four other dead specimens (S. Afr. Mus. no. 4753), locality unknown, but probably also Cape Town, 17 × 9, 24 × 12, 26 × 14, and 29 × 15 mm. are rather plump. The 2 larger ones are thick-walled, the largest especially so, with a thickened and strongly plicate outer lip. These were identified as *magellani* by J. H. Ponsonby.

There are two dead shells, 19 × 10 and 27 × 15 mm., from Table Bay (S. Afr. Mus. 5465); the larger is thick-walled, and both have the outer lip plicate.

Very different, at first glance, from these thick-walled specimens, are 4 specimens from the P.F. collection but without exact locality (S. Afr. Mus. A4732). One was taken alive, and the operculum, but not the animal, was preserved. They are all thin-walled and slender: 25 × 10 and 26 × 11 mm. Nevertheless they conform in all characters with the above description.

The 'straight' sides, regularity of the spiral sculpture, and the large number of costae on the base distinguish this species from *elongata*.

Smith's suggestion that *magellani* from St. Paul Island might be synonymous seems rather unlikely, but should be investigated. Sowerby's record (1897) of *magellani* from Natal is certainly erroneous.

In spite of Thiele's statement that the *Valdivia* specimen is different in shape from *Euthria capensis*, it might perhaps be assigned to this species or to *elongata*. Thiele described it (or another specimen) as *Pisania costata*. There is a specimen from Sea Point (Cape Town) (S. Afr. Mus. no. 4974) of almost the same size (Thiele 18 × 7·5 mm., S. Afr. Mus. 18 × 8 mm.); if Thiele's figure correctly indicates the size of the costae in the subsutural groove, and the number of costae on the base, *Pisania costata* can well be regarded as a *capensis*. The axial ribs, however, appear from the figure (the number is not given in the description) to be fewer. Von Martens's and Thiele's locality: 34° 51′ S. 19° 37′ E., 80 metres.

There is little difference in Petit's figure of his *simonianus* and von Martens's figure of *lacertina*. I think there is little doubt that *simonianus* should fall into the synonymy of *capensis*.

* Named after M. de Saint-Simon, not after Simon's Bay.

The difficulty of assigning some specimens to a particular species is shown by the following description of a specimen labelled by Sowerby (3rd) as '*simoniana* juv.' with a query.

Fusiform, profile of whorls very slightly convex. Protoconch 2½ whorls, diam. and alt. 1 mm., smooth. Postnatal whorls 5; low axial ribs 13 on 1st whorl, increasing to 18 on last, on 1st–3rd whorls distinct from suture to suture, but becoming indistinct on 4th and first part of 5th and indicated only by a double row of feeble peripheral knobs, and obsolete on body whorl; crossed by very fine spiral striae, visible chiefly between suture and periphery on last two whorls and on base, on the latter there are 4 or 5 slightly stronger lirae, and half a dozen closer together on rostrum. No parietal callus, columella curved, canal rather narrow and reflexed, outer lip simple. 21 × 9 mm. Pale buff.

Off East London, 40 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. This specimen is closely similar to a 22 × 10 mm. specimen of *Afrocominella elongata* from Qolora, and also with some of the specimens (A4732) referred to *A. capensis*, though much smoother.

Afrocominella turtoni (Bartsch)

1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 50, pl. 3, fig. 6 (*Euthria t.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 54 (*Euthria t.*).

Spire turreted. Profile with shoulder at middle of whorl. Protoconch 2½ whorls, diam. 1·2, alt. 1 mm., smooth. Postnatal whorls 5; axial ribs 10 on 1st and 10–11 on 2nd whorl, increasing to 12 on 5th whorl, from suture to suture on 1st and 2nd, but from 3rd whorl onwards evanescent between suture and periphery, where they form prominent shoulder knobs; not extending across base; crossed by 4–5 fine spiral lirae on 1st whorl, on 2nd whorl 4 above and 3 below the (incipient) shoulder, increasing to 12–15 above and 10–12 below on 5th whorl; base with *c.* 30 additional closely packed lirae, of which 7 or 8 are slightly stronger than the others. Parietal callus not developed, canal straight, outer lip not plicate within. 22 × 9·5 mm.

Operculum oval, nucleus apical, scarcely incurved, 5 × 2·5 mm. in 22 mm. shell with 11 mm. aperture.

Castaneous above the shoulder, and between the knobs, ochraceous below, operculum amber. Animal pale with dark grey speckling around foot.

Radula with *c.* 120 rows, central plate about as long (incl. cusps) as wide, base rectangular, with 3 cusps, lateral plate with bifid inner cusp.

St. Francis Bay (34° 15′ S. 25° 5′ E.), 6 fathoms (U.C.T.).

Remarks. The above description is taken from the, as yet, only specimen known to have been collected alive. Its radula showed it to be an *Afrocominella*. This was not unexpected because Turton said (loc. cit., p. 52) that some of his specimens were identified by Smith as *capensis*, and S. Afr. Mus. specimens with the *turtoni* coloration were identified many years ago by J. H. Ponsonby as *elongata*.

Beach-worn examples from Port Alfred and Still Bay (S. Afr. Mus.) up to 40 mm. in length, with 6–7 whorls, yellowish or orange-brown and showing more or less the castaneous patches between the knobs, agree in sculpture with the above description. A second row of less prominent nodules below the shoulder knobs is sometimes present. The parietal callus is nodiform.

Three P.F. specimens, dirty white without any colouring, also agree, but are thicker walled, especially the largest. The outer lip tends to be slightly exsert and thickened within, with about 10 denticles in the largest specimen (merely indicated in the other two).

33 (apex and rostrum broken) × 17 mm. (7 whorls); 26 (apex and tip of rostrum broken) × 12 mm. (6 whorls); 17·5 × 8 mm. (5 whorls).

Off Great Fish Point, 57 fathoms (largest); off East London, 32 fathoms; off Hangberg (Knysna, *not* Hangklip, False Bay), 48 fathoms (smallest); one dead but fresh example from each locality (S. Afr. Mus. P.F. coll.).

Gen. Burnupena Iredale

1917. Cooke. *Proc. Mal. Soc.*, xii, p. 227 (radulae) (*Cominella* s.l.).
1918. Iredale. ibid., xii, p. 34, line 24.
1926. Tomlin. *Ann. Natal Mus.*, v, p. 291.
1929. Thiele. *Handbuch*, i, p. 315 (incl. *Afrocominella*).
1938. Bokenham & Neugebauer. *Ann. Natal Mus.*, ix, p. 133 (egg-capsule).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 97, and 1939, p. 270 (radulae).
1944. Stephenson. *Ann. Natal Mus.*, x, p. 344 (list of species, *Cominella*).
1947. id. ibid., xi, pp. 271–4 (distribution and notes on species, *Cominella*).
1951. Barnard. *Beginner's Guide S. Afr. Shells*, fig. 35 (egg-capsule).
1956. Orr. *Proc. Ac. Nat. Sci. Philad.*, cviii, p. 250 et sqq. (revision and ecology of species).*

Ovate, sometimes slightly fusiform, spire low or not very high. Subsutural canal usually distinct. Canal short. Fasciole distinct. Early whorls either cancellate-nodulose (axial ribs on 1st whorl *numerous*: 18–20), or with spiral sculpture only.

Penis with apical prong. Radula central plate wider than long, with (3–4 juv.) 5–7 (8) cusps, lateral plate with strong (usually not so strong as in *Afrocominella*) outer cusp and trifid inner cusp. Malformations and asymmetry frequent.

Genotype: *cincta* (Bolten-Röding).

Remarks. The egg-capsule and protoconch described below undoubtedly belong to a *Burnupena*, but whether the species is *cincta* or *papyracea* is uncertain. I have found them at St. James (False Bay), and Bokenham and Neugebauer collected them at Sea Point (Cape Town) and St. James. Actual spawning has not been observed.

After examining the S. Afr. Mus. collection (mostly dead specimens), and the large U.C.T. collection of material taken alive by Prof. Stephenson and Prof. Day, I have come to the conclusion that six species: *cincta*, *lagenaria*,

* Some typ. err. and laps. cal. In the Bibliography, Bokenham & Neugebauer 1938, for '*Tr. Roy. Soc. S. Afr.*' read: *Ann. Natal Mus.*; for 'Piele' read: Peile.

papyracea, *limbosa*, *delalandii* and *tigrina*, can be more or less satisfactorily separated.

Stephenson's remarks (1947, p. 272), however, are fully justified. Some examples are impossible to assign definitely to one species or another, owing to the frequent occurrence of intergrading forms which Stephenson suggested might possibly be hybrids. The two most confusing pairs are *cincta-lagenaria* and *limbosa-delalandii*. But in spite of intergrading forms, the extremes are distinctive, and for this reason might well be retained as separate species.

A. Early whorls with spiral sculpture only.
  1. Whorls with spiral lirae and more or less numerous well-marked costae. Pale spots around spire (if not corroded).
    a. Angle of spire 50°–65° . . . . *cincta*
      (intermediates)
    b. Angle of spire 70°–85° . . . . *lagenaria*
  2. Numerous striae and lirae, but none enlarged to costae.
    a. Subsutural groove not, or only feebly, developed. Profile of whorls evenly convex. Aperture white . . . . *papyracea*
      (intermediates)
    b. Subsutural groove well developed.
      i. Brown, aperture more or less suffused . . . . *limbosa*
        (intermediates)
      ii. Purplish-brown, aperture deeply suffused purplish-brown or violaceous . . . . *delalandii*
B. Early whorls cancellate-nodulose, the axial ribs numerous (18–20) . . . *tigrina*

To Stephenson's summaries of the distribution of each species are added the localities of the S. Afr. Mus. examples (when definitely known). Little reliance, however, can be placed on some of the earlier records.

Only selected references to each species are given, mainly those of recent years. In some cases likely synonyms are suggested.

Since the completion of my study of this genus, Miss Orr's valuable paper has appeared. It is refreshing to have a revision of a genus based on living material personally collected and studied in the field. After investigating habitats and ecology at several localities around the South African coast, Miss Orr has reduced the number of species to two; *papyracea* and *delalandii*, the former with *papyracea* s.s., *cincta*, *lagenaria* and *tigrina* as subspecies.

To some extent shell characters were found correlated with habitat, e.g. the strongly costate *cincta* inhabits intertidal pools along the south coast, finely striate form :being found in the colder subtidal zone, and especially on the west coast; shells in sheltered situations usually have higher spires than those from exposed habitats.

Basically there is little difference between Miss Orr's conclusions and my own; the main difference concerns the taxonomic status of the forms. Feeling that the last word, ecologically and taxonomically, has not been said, I am retaining my diagnoses.

The spawning habits need investigation. And if in the future it should be found possible to breed these molluscs under artificially controlled conditions,

instructive results may be obtained. It would be interesting, for example, to see what sculpture would be found on the progeny of a *cincta* × *tigrina* hybrid (cf. fig. 32(*e*) and (*f*)).

Burnupena cincta (Bolten)

Figs. 31(*g*), 32 (*a-d*), (*e*)

1790. Gmelin. *Syst. Nat.*, ed. 13, p. 3494, no. 105 (*Buccinum porcatum*, non da Costa 1778).
1798. Bolten-Röding. *Mus. Bolten.*, p. 113.
1874. Von Martens. J.B. *D. Malak. Ges.*, p. 136 (*Buccinum p.*).
1886. Watson. *Challenger Rep.*, xv, p. 214 (*Cominella p.*) (references).
1889. Studer. *Forschungsreise d. 'Gazelle'*, III, pp. 52, 55 (*Buccinum p.*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 52 (*Cominella p.*).
1917. Cooke. loc. cit., p. 229, fig. 1 *b* (radula) (*Cominella p.*).
1918. Iredale. ibid., xiii, p. 34.
1926. Tomlin. *Ann. Natal. Mus.*, v, p. 291.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 52, pl. 12, no. 381 (*cincta* var. *adjacens*).
1937. Stephenson and others. *Tr. Roy. Soc. S. Afr.*, xxvi, p. 357.
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 97 and p. 98 (*dunkeri* (radula).
1938. Stephenson. *Ann. Natal Mus.*, ix, p. 10.
1938. Eyre and others. ibid., ix, p. 96.
1938. Bokenham & Neugebauer. ibid., ix, p. 133, pl. 16, figs. 1–3, 5, 6, 9 (egg-capsule, development, protoconch).
1939. Eyre. ibid., ix, p. 298.
1940. Broekhuysen. *Tr. Roy. Soc. S. Afr.*, xxviii, pp. 255 *et passim* (fig. 1 chart of vertical distribution).
1947. Stephenson. *Ann. Natal Mus.*, xi, pp. 272, 273.
1952. Day and others. *Tr. Roy. Soc. S. Afr.*, xxxiii, p. 410.
1956. Orr. loc. cit., p. 254, pl. 19, figs. 5, 6, text-fig. 1 *b, c*, pl. 20, fig. 2.

No axial sculpture on any of the whorls. Aperture a little longer than spire. Ratio breadth to length = 1 : 1·6–2. Angle of spire 50°–65°. Protoconch ovoid, 2½ whorls, diam. 1·3–1·5 mm., alt. 2–2·5 mm.* (specimens taken from egg capsules), smooth but with *c.* 15 spiral lirae beginning on last half whorl. Postnatal whorls 7, with subsutural groove; 3 broad flattish spiral costae, the uppermost adjoining suture, the 2nd forming lower border of subsutural groove, the 3rd usually partly or wholly covered on the upper whorls by the succeeding whorl; 3 (nos. 4, 5, 6 in fig. 32(*a*)–(*d*)) additional costae on base of body whorl; usually an additional narrower costa between each pair of major costae, but not between 1st and 2nd (except in one specimen); costae and grooves (incl. subsutural groove) with fine spiral striae. Parietal callus dentiform; canal reflexed; outer lip undulate on margin (corresponding with the costae), but usually not plicate internally (in fresh intact specimens the actual edge may be finely crenulate, corresponding with the striae). Periostracum thick, fibrous-fimbriate. 59 (apex corroded) × 31 mm. Plump and slender forms, e.g. 50 × 30 mm. and 51 × 27 mm. (same locality).

Operculum ovate, somewhat unguiform, apex incurved, 23 × 11 mm. in 55 mm. shell.

* i.e. including the sculptured portion—smooth portion 0·9–1 mm.

Orange-brown with darker marks and spots alternating with white marks on the major costae; coloration obscured in living examples by dark brown periostracum, except on the upper whorls where the alternate brown and white 'necklace' remains on 1st and 2nd costae; in large specimens the early whorls are nearly always corroded; aperture and columella white, but outer lip sometimes slightly suffused internally; operculum dark brown. First whorl of protoconch white, second fawn. Periostracum often stained with green algae. Animal mottled or streaked with blackish-grey.

Radula with 110–120 rows, central plate wider than long, with 6 denticles (sometimes only 5), lateral with trifid inner cusp, the 2 inner prongs feebly serrulate on their opposing edges. Peile: denticles on central 5–9, usually 6–7, his fig. 33 of *dunkeri* is a juvenile radula with central plate not so wide as in adult and with only 3 cusps.

Egg-capsule a triquetral prism, length 7–9 mm., maj. diam. 3–3·5 mm.; outer (convex) surface with a median keel in the basal quarter or third; apex sometimes fimbriate. Numerous capsules are attached by their base in oval or circular clumps, $\frac{1}{2}''$ to $2''$ in diameter, to rock-surfaces or fronds of seaweeds.

Living: False Bay to The Haven (north of East London), and sporadically on west coast as far north as Steenberg Cove (St. Helena Bay) (Stephenson 1947); also Richmond (Alexandria Division) (U.C.T. Ecol. Surv.); the west coast localities are Sea Point (Cape Town), Langebaan, Steenberg Cove, and Lüderitzbucht (U.C.T.). Simon's Bay (False Bay) 10–20 fathoms (Watson). Kalk Bay and Zwartklip in False Bay (S. Afr. Mus. coll. K.H.B.).

Dead: several localities within the above range (previous authors, and S. Afr. Mus.). 34° 6′ S. 18° 6′ E., 117 fathoms (Studer), Saldanha Bay, and other localities to Natal (von Martens), Cape Congo, Angola (Orr).

Remarks. As a rule the spiral costae are well developed and broad; where intermediaries are developed the major costae tend to be narrower. On the body whorl there is a possible maximum of 10: 6 major and 4 intermediaries (fig. 32(*a*)); a total of 7, 8 or 9 is common, but 10 is rare. Sometimes nos. 2, 3 and intermediary 2*a* are subequally narrow (fig. 32(*b*)); in another variation all the costae may be narrow and consequently widely spaced (fig. 32(*c*)).

In only one specimen have I seen an intermediary in the subsutural groove between the 1st and 2nd major costae, thus tending to obliterate the groove (fig. 32(*d*)).

The costae are sometimes very flat.

There are high-spired (*cincta* s.s.) and low-spired forms, the latter being broader, more squat, and approaching the *lagenaria* shape (cf. Stephenson 1947). The U.C.T. collection has transitional examples from Langebaan (West Coast), St. James (False Bay), Danger Point, Cape Agulhas, Mossel Bay, Kleinmond and Richmond (Bathurst and Alexandria Div.), Qolora, Port St. Johns.

From Lüderitzbucht (U.C.T. L.U. 29.C.) I have seen two specimens of

somewhat squat form, brightly coloured with flames in the subsutural groove, and 'necklaces' of dark and light spots on each costa.

One specimen from Kalk Bay (False Bay) with aberrant operculum: oval with subcentral nucleus (cf. *lagenaria* aberr.).

Burnupena lagenaria (Lam.)

Fig. 31 (*h*)

1822. Lamarck. *Anim. sans Vert.*, vii, p. 245 (*Purpura l.*).
1832. Duclos. *Ann. Sci. Nat.*, xxvi, p. 112, pl. 2, fig. 12 (*P. cucurbita*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 52 (*Cominella l.*).
1910. Schwarz. *Tr. Geol. Soc. S. Afr.*; xii, p. 114.
1917. Cooke. *Proc. Mal. Soc.*, xii, p. 229, fig. 14 (radula).
1922. Tomlin. *J. Conch.*, xvi, p. 260.
1929. Thiele. *Handbuch*, i, fig. 349 (radula).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 97 (radula).
1938. Stephenson and others. *Ann. Natal Mus.*, ix, p. 10.
1938. Eyre and others. ibid., p. 96.
1938. Eyre. ibid., p. 298.
1947. Stephenson, ibid., xi, pp. 272–4.
1956. Orr. loc. cit., p. 256, pl. 19, fig. 9, text-fig. 1 *g*, *h*.

No axial sculpture on any of the whorls. Proportionately broader than *cincta*: ratio breadth/length 1 : 1·3–1·6; angle of spire 70°–85°. Fine spiral lirae on all whorls. Spiral costae as in *cincta*, i.e. 6 major costae with a varying number of intermediaries (1–4), but much flatter and less well developed; nevertheless, the major costae, though faint, can be distinguished from the finer lirae. Parietal callus dentiform; outer lip more often plicate on margin but the plicae not extending internally. Upper whorls usually corroded. 40 × 26 mm.

Operculum ovate, apex somewhat incurved, 12 × 8 mm. in 30 mm. shell, 14 × 8 in 32 mm. shell.

Coloration similar to that of *cincta*: in worn shells the 'necklace' pattern is well marked, but not so obvious when covered by the periostracum; outer lip internally strongly suffused with orange-brown or chestnut, often with a livery tinge (Krauss: 'brownish-violet'), paler at the actual margin.

Radula with 120–130 rows, central plate wider than long, with 6(7) denticles (Thiele's figure shows 5 denticles with a minute 6th at one side; Cooke shows 6 plus 1; Peile gives 4–8, 5 being the normal number); lateral with trifid inner cusp.

Fossil: Pleistocene, Port Elizabeth (Schwarz).

Living: False Bay to Umhlali, Natal (Stephenson 1947); Zwartklip, False Bay (S. Afr. Mus. coll. K.H.B.).

Dead: various localities within the above range (previous authors); also Walfish Bay (von Martens); Lüderitzbucht (von Martens, Tomlin); Table Bay (von Martens).

Remarks. The broad squat form with deeply suffused aperture is easily distinguished from the high-spired *cincta* with pale aperture. But there are intermediates combining a high spire with a suffused aperture.

Moreover, juveniles are often particularly difficult to assign to one or the other species. See Stephenson 1947, and examples in U.C.T. Ecol. Surv. Coll.

Aberrations. One freak subscalariform specimen taken alive in False Bay (S. Afr. Mus. 11117), 27 mm. long, has the spire 13 mm., width 14 mm. aperture 14 mm. long, (ratio breadth/length almost 1 : 2); angle of spire approx. 40°. Almost the whole shell is badly corroded, but the uncorroded part (*c*. 10 mm.) of the last whorl retains the periostracum and shows 6 very flat major costae, with intermediaries anteriorly; aperture internally suffused. Identified by Tomlin as *lagenaria*; I agree.

In one specimen the operculum is oval with nucleus subcentral. (cf. *cincta* aberr.).

Burnupena papyracea (Brug.)

1789. Bruguière. *Encycl. Meth. Vers.*, I, p. 260 (*Buccinum p.*).
1816. Lamarck. *Tabl. Encycl.*, pl. 400, figs. 3 *a*, 3 *b*, and Liste, p. 2 (*Buccinum p.*).
1846. Reeve. *Conch. Icon.*, pl. 5, sp. 32 (*Buccinum intinctum*).
1848. Krauss. *Südafr. Moll.*, p. 120 (*Buccinum intinctum*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 52 (*Cominella p.*).
1922. Tomlin. *J. Conch.*, xvi, p. 260.
1938. Bright. *Trans. Roy. Soc. S. Afr.*, xxvi, pp. 62, 72.
1939. Peile. *Proc. Mal. Soc.*, xxiii, p. 270.
1940. Stephenson and others. *Ann. Natal Mus.*, ix, p. 356.
1947. Stephenson. ibid., xi, pp. 273, 274.
1956. Orr. loc. cit., p. 252, pl. 19, figs. 1–4, text-fig. 1 *d, e*.

Profile of whorls convex, without subsutural groove except sometimes a trace on last whorl in adult. Protoconch 2½ whorls, diam, and alt. 1·5 mm., smooth. Postnatal whorls 5; spiral lirae 5 on 1st whorl, increasing to 14–15 on last whorl, with *c*. 20 additional on base; on early whorls the lirae regular in size and spacing, but on base the alternating intermediaries are weaker. Parietal callus dentiform; outer lip very feebly indented posteriorly in adult, internally plicate. 45 (apex broken) × 26 mm.; 57 (apex and lower part of outer lip worn) × 32 mm.

Operculum ovate, apex somewhat incurved, 15 × 7 mm. in 40 mm. shell.

Uniform yellow, orange-brown or castaneous, aperture internally white (except in thin-walled juveniles), periostracum and operculum brown.

Radula with 115 (one specimen examined; Peile 95–100) rows, central plate with 6 denticles, lateral with trifid inner cusp, the 2 inner points with their opposing margins feebly serrulate.

Living: west coast from Port Nolloth to Cape Peninsula, and eastwards as far as Hermanus (Stephenson 1947); Lüderitzbucht (U.C.T.).

Dead: Still Bay and Port St. Johns (S. Afr. Mus.); Lüderitzbucht (von Martens, Tomlin); Olifants River, Table Bay, False Bay, Pondoland (von Martens); other records by previous authors, extending to Natal, require confirmation.

Distribution. Gabun, French Equatorial Africa (Orr).

Remarks. Description based on specimens (S. Afr. Mus.) identified by Tomlin, who used the name *papyracea.* Krauss preferred to regard the South African specimens as a species different from the Norwegian (*fide* Kiener) *papyracea* under the name *intincta* Rve.

The uppermost 4 lirae on the penultimate and ultimate whorls occupy the space of the undeveloped subsutural groove; the 4th may be a trifle stronger and form a very obscure shoulder (but without a concave groove above). The convex, in plump examples almost globose, profile of the whorls is the most noticeable feature. The white aperture also seems characteristic.

The plicae within the aperture are already developed in juveniles 6–7 mm. long.

Two specimens in the *Pieter Faure* collection (S. Afr. Mus. no. A8607. P.F. 12558) come from: Cape Natal W × N ¾ N. 185–200 fathoms. The depth seems excessive for species of this genus, and probably the specimens have been mislabelled.

Frequently covered with a dark purplish-brown Polyzoan (*Alcyonidium nodosum*), which is not known to occur on any other shell (Stephenson, 1947, p. 273). I have examined the U.C.T. Ecol. Survey collection and can confirm Stephenson's statement. Whenever *limbosa* and *papyracea* occurred at the same locality, specimens with the Polyzoan coat proved to be *papyracea* as here diagnosed.

Specimens of *tigrina*, however, were also found to be covered with a very similar growth, which has not yet been identified.

Burnupena limbosa (Lam.)

1822. Lamarck. *Anim. sans Vert.*, vii, p. 243 (*Purpura l.*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 52 (*Cominella l.*).
1908.* Melvill & Standen. *Tr. Roy. Soc. Edinb.*, xlvi, 1, p. 154.
1909. id. *Sci. Res.* '*Scotia*', v, p. 124 (reprint of previous paper).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 47, pl. 4, fig. 6 (*C. porcata* var. *multilirata*).
1917. Cooke. *Proc. Mal. Soc.*, xii, p. 229, fig. 15 (radula) (*Cominella l.*).
1923. Odhner. *Göteb. K. Vet. Handl.*, xxvi, p. 6 (*Cominella l.*).
1926. Tomlin. *Ann. Natal Mus.*, v, p. 291.
1938. Bright. *Tr. Roy. Soc. S. Afr.*, xxvi, pp. 58, 62.
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 97 (radula).
1939. id. ibid., xxiii, p. 270, fig. 38 (radula).
1940. Stephenson and others. *Ann. Natal Mus.*, ix, p. 356.
1947. Stephenson. ibid., xi, pp. 273, 274.
1956. Orr. loc. cit., p. 252 (as syn. of *papyracea*).

Ratio breadth/length 1 : 1·6–1·8. Angle of spire 70°–90°. Aperture twice spire. Protoconch ? Postnatal whorls ? 5. Subsutural groove present, but no sutural costa. Whole whorl with numerous spiral lirae of almost equal strength, but those on base somewhat stronger. Parietal callus dentiform; canal reflexed; outer lip with numerous plicae extending inwards from the margin. Perio-

* Issued separately 1907.

stracum thick, fibrous-fimbriate. 60 × 38 mm. Also: 58 × 31 mm. (apex and lower part of outer lip worn), 56 × 33 mm.

Operculum ovate, apex somewhat incurved, 17 × 9 mm. in shell 41 × 26 mm.

Uniform yellowish-brown, aperture more or less suffused with fawn at margin internally, periostracum brown, operculum dark brown.

Radula with *c.* 130 rows, central plate with 6 denticles (Peile gives 6–8, usually 7), lateral with trifid inner cusp. Peile (1939) figures a variation.

Living: west coast from Port Nolloth to the Cape Peninsula, further east? (Stephenson 1947).

Dead: Table Bay (Sowerby, and S. Afr. Mus.); Walfish Bay, Lüderitzbucht, Saldanha Bay, Table Bay (von Martens); other records by previous authors require confirmation.

Remarks. Distinguished from *lagenaria* by the uniform strength of the lirae, without any suggestion of major costae; and also by coloration.

Why *multilirata* was made a subspecies of *porcata* (= *cincta*) was not explained by Bartsch; it appears to be a normal specimen of *limbosa*.

Orr regards *limbosa* as a synonym, not even a subspecies, of *papyracea papyracea* (p. 253).

Burnupena delalandii (Kiener)

1833. Quoy & Gaimard. *Voy. Astrolabe Moll.*, p. 456, pl. 30, figs. 32–34 (*Buccinum violaceum*).
1834. Kiener. *Coq. Viv.*, p. 33, pl. 8, fig. 23 (*B. violaceum*).
1834. id. ibid., ix, p. 15, pl. 5, fig. 14 (*Buccinum delalandii*).
1848. Krauss. *Südafrik. Moll.*, p. 120 (*Buccinum v.* and *d.*).
1917. Cooke. *Proc. Mal. Soc.*, xii, p. 229, fig. 13 (radula) (*Cominella d.*).
1918. Iredale. ibid., xiii, p. 34 (*Burnupena delalandii*).
1923. Odhner. *Göteb. K. Vet. Sam. Handl.*, xxvi, p. 6 (*Cominella d.*).
1926. Tomlin. *Ann. Natal Mus.*, v, p. 291 (*Afrocominella d.*).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 97, fig. 31 (radula).
1938. Bright. *Tr. Roy. Soc. S. Afr.*, xxvi, pp. 76, 84, 86, 87 (*Cominella d.*).
1940. Stephenson and others. *Ann. Natal. Mus.*, ix, p. 356 (*Cominella d.*).
1947. Stephenson. ibid., xi, pp. 272, 273 (*Cominella d.*).
1956. Orr. loc. cit., p. 258, pl. 19, fig. 10, text-fig. 1 *f*, pl. 20, fig. 1 (*delalandii*).

Aperture a little larger than spire. Protoconch 2½ whorls. Postnatal whorls 5; subsutural groove present; spiral striae on all whorls, about 8 on 3rd whorl increasing to 15–20 on later whorls, with *c.* 16 additional ones on base, the latter becoming slightly deeper and farther apart anteriorly (more like shallow sulci). Parietal callus dentiform; outer lip indented posteriorly, posterior canal well marked; internally plicate. Periostracum fibrous-fimbriate. 55 (apex corroded) × 30 mm.

Operculum ovate, somewhat curved inwards apically; 20 × 10 mm. in 55 mm. shell.

General coloration dark purplish-brown, especially juveniles, larger examples show purplish lirae on a paler ground colour on the base and where the periostracum is worn; sometimes with dark axial flames on the paler

ground, but these more often visible in dead and worn specimens than living; periostracum brown; aperture violaceous or purplish-brown, operculum dark brown.

Also, flames appear to be more frequently developed in some localities e.g. Langebaan Lagoon and Hondeklip Bay.

Radula with *c.* 110–120 rows; central plate wider than long, 6–7 denticles (Peile gives 4–7, usually 6), lateral with trifid inner cusp, the inner and middle points of which are feebly serrulate on their opposing margins.

Living: Stephenson (1947) records this species as common on the west coast from Port Nolloth southwards, and extending on the south coast as far as Hermanus.

In view of Stephenson's results, based on living material, the records of Bartsch and Turton (6 specimens and 1 resp.) which are the only records east of Cape Agulhas, can be disregarded.

Dead: (*violacea*) Table Bay (Quoy & Gainard); (*delalandii*) Cape (Kiener); Dyer Island (Agulhas) (Odhner). Kalk Bay (False Bay), Dassen Island (Table Bay), (S. Afr. Mus.).

Remarks. The dark purplish colour with violaceous aperture of living examples is distinctive, and suggests that this was the species collected in Table Bay and described by Quoy & Gaimard as *violacea*. However, as I have not seen the original figures, or the specimen (if it is still extant!), and as there are other possible shells (e.g. *Thais capensis*, *T. dubia*, perhaps even a worn and stained *Fasciolaria lugubris*), Kiener's name is retained. Orr regards *violacea* as a synonym of *papyracea cincta*.

The apices of all specimens I have seen are more or less corroded; consequently the details of the protoconch and first two whorls cannot be given. Smallest specimen seen 8·5 mm. long.

There are slender and plump examples, irrespective of sex, e.g.:

♂♂ 29 × 19, 34 × 21 mm.
♀♀ 30 × 18, 33 × 21, 34 × 22, up to 53 × 32, 55 × 30 mm.

There are no clear-cut conchological differences between this species and *limbosa*. Fresh specimens may be separated by coloration, but worn and faded individuals are impossible to assign to one or the other 'species'.

Burnupena tigrina (Kien.)

Fig. 32(*f*)

1834. Kiener. *Coq. Viv.*, ix, p. 27, pl. 10, fig. 32 (*Buccinum t.*).
1848. Krauss. *Südafr. Moll.*, p. 120 (*Buccinum t.*) (says name is preocc. by Gmelin and must be changed).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 10, pl. 1, fig. 7 (*Cominella semisulcata*).
1917. Cooke. *Proc. Mal. Soc.*, xii, p. 229, fig. 12 (radula) (*Cominella t.*).
1918. Iredale. ibid., xiii, p. 34.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 51, pl. 12, no. 379 (*Cominella translucida*).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 97, fig. 32 (radula).

1947. Stephenson. *Ann. Natal Mus.*, xi, pp. 273, 274.
1956. Orr. loc. cit., p. 255, pl. 19, figs. 7, 8, text-fig. 1 *a*.
Not 1917. Cooke. *Proc. Mal. Soc.*, xii, p. 229, fig. 12 (radula) (= *A. elongata*).

Aperture longer than spire. Protoconch $2\frac{1}{2}$ whorls, diam. 1·3 mm., smooth but with nodulose-cancellate sculpture in last half whorl. Postnatal whorls 6; early whorls cancellate-nodulose; 18 (19) riblets on 1st whorl, increasing to *c.* 28–30 on last whorl, extending from suture to suture except on 5th and 6th whorls where they form only nodules on the subsutural costa and the costa forming lower border of subsutural groove, and less distinctly on some of the costae below; spiral costae 4 (sometimes 5), of equal strength on 1st and 2nd whorls, but on 3rd and later whorls the subsutural costa and the one forming the shoulder become stronger than the others; also from 3rd whorl onwards an intermediary develops in the subsutural groove, increasing to 3 or 4 on last whorl; 9–10 additional costae on base; all the costae and intervening grooves may have fine lirae. Parietal callus dentiform; outer lip indented posteriorly, internally smooth (lirae showing through half-grown shells simulate plicae, but this is due to colour only, not sculpture). Periostracum fibrous. 40 × 22 mm., 41 × 20 mm.

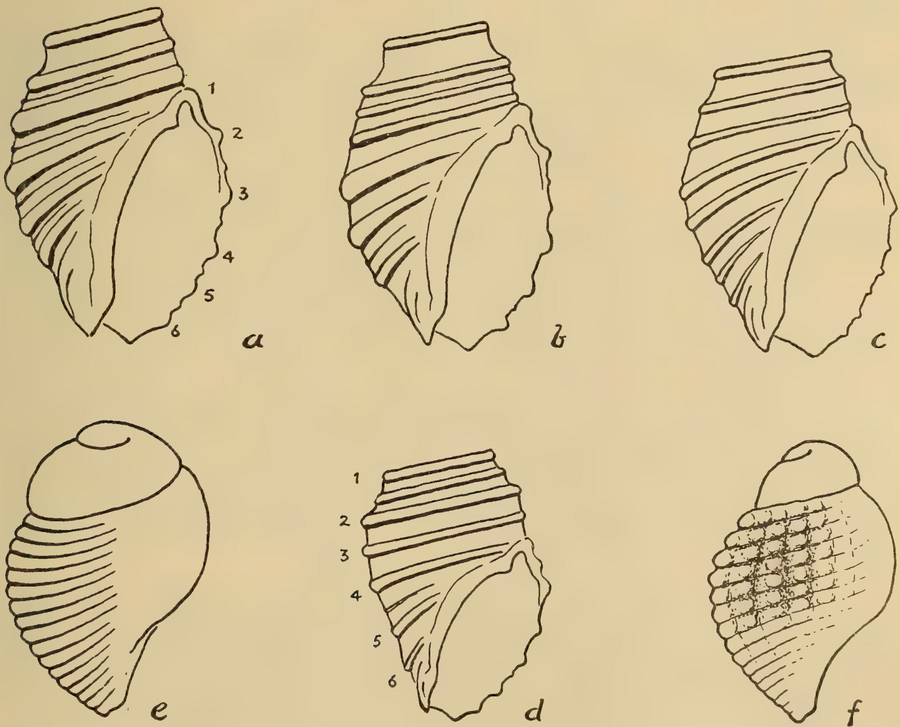


FIG. 32.
(*a*)–(*d*) *Burnupena cincta* (Bolten) body whorl to show variation of costae (semi-diagrammatic). (*e*) protoconch. (*f*) *B. tigrina* (Kien.) protoconch.

Operculum ovate, somewhat incurved apically, 8·5 × 4 in 25 mm. shell.

'Leonine' coloration: uniform tawny or yellowish-brown, periostracum a little darker.

'Tigrine' coloration: with chestnut or reddish-brown spots and marks on the costae forming irregular, more or less disconnected axial undulate or zigzag flames; very obvious in beach-worn specimens, but more or less obscured by the periostracum in fresh specimens.

Radula with 100–115 rows, central plate twice as broad as long, with 5–6 denticles, the 6th being sometimes minute, lateral with trifid inner cusp, the opposing margins of the 2 inner points feebly serrulate. (Cooke's description and figure incorrect—see Peile 1938.)

Living: Still Bay and East London (Stephenson 1947); False Bay, Hermanus, Mossel Bay, Jeffreys Bay, Port Elizabeth (U.C.T. Ecol. Surv.); False Bay, 9 fathoms, and off Cape St. Blaize, 17 fathoms (S. Afr. Mus. P.F. coll.); Saldanha Bay (west coast) (U.C.T.).

Dead: records by previous authors are within the above range. Kalk Bay and Muizenberg (False Bay), Still Bay, Mossel Bay, Port St. Johns, Cove Rock (near East London), and Durban (S. Afr. Mus.); on the west coast: Dassen Island (Table Bay), and Lambert's Bay (S. Afr. Mus.).

Remarks. The above description based on 3 specimens with the 'leonine' coloration from False Bay, one of them identified by Tomlin.

There are plump and slender forms: e.g. 40 × 22 mm., and 41 × 20 mm.; the uniformly coloured 'leonine' examples are mostly plump, the 'tigrine' examples on the other hand tend to be more slender.

Some specimens have faint indications of spots and flames and constitute transitions between the 'leonine' and 'tigrine' forms.

Sowerby had one specimen, 50 × 24 mm., for his description of *semisulcata.* His figure is not good, because the subsutural groove is drawn too deep, simulating a sunken suture, whereas the actual suture lies above the upper series of nodules. There appear to be no later records of this form.

Five beach-worn specimens (S. Afr. Mus. Ross-Frames coll.), however, seem referable. On the 4th and 5th whorls the gradually disappearing axial ribs give a beaded appearance to the subsutural costa, and less obviously to the shoulder below the groove; but eventually they disappear completely. The sculpture of the early whorls resembles that of *tigrina.* 56 (apex and end of rostrum worn) × 24 mm.; smallest 25 × 13 mm.

Variation. In four 'leonine' specimens from Muizenberg (False Bay) (S. Afr. Mus. no. A4936), largest 38 mm. long, the early whorls are cancellate-nodulose, but on 4th and 5th whorls the nodules become very feeble and eventually obsolete, the subsutural costa is only slightly developed, the subsutural groove is scarcely concave; the major costae (3) on body whorl and 5 or 6 of those on base are distinct in one specimen, feeble in another, and scarcely stronger than lirae in the other two.

The Dassen Island specimen (S. Afr. Mus. no. 6886), 28 mm. long, 4 whorls, aperture plicate, has the whorls distinctly nodulose but the nodules peter out on later part of 4th whorl; and each one of the major costae tends to be divided by an incised stria. This latter feature is very noticeable in the Lambert's Bay specimen (S. Afr. Mus. no. 9686).

In two juveniles, 12 and 19 mm. long, from Mossel Bay, only the 1st, 2nd and part of the 3rd whorl are cancellate-nodulose; subsutural costa not developed, major costae merely indicated. Two other slightly larger specimens from the same locality are typical *tigrina* in sculpture and coloration.

In the 'tigrine' form there are on the 5th and 6th whorls usually only 2 costae visible below the subsutural groove; but sometimes the succeeding whorl may recede far enough to expose, partly or wholly, a 3rd costa.

'Cominella' *angusta* Sow.

1886. Sowerby. *J. Conch.*, v, p. 4.
1892. id. *Mar. Sh. S. Afr.*, p. 10, pl. 1, fig. 8.
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 49.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 53.

Aperture shorter than spire. Protoconch ? Postnatal whorls ? (Sowerby: 8 incl. protoconch). Sculpture clathrate; axial riblets 11 on 1st whorl, increasing to 15 on 5th [largest specimen seen by me]; crossed by spiral lirae, 4 on 1st whorl increasing to 6–7 on last whorl, with 8–9 additional ones on base. Columella curved, no parietal callus; no fasciole: outer lip not indented. $12 \times 4{\cdot}75$ mm.; Sowerby: 14×4; Turton: 15 mm.

Operculum and radula ?

(When fresh) yellowish with reddish spots: 'in a single or double row just below middle of whorl' (Sowerby); one 'on every alternate rib just above the suture' (Turton); (when worn) pure white.

Dead: Port Elizabeth (Sowerby); Port Alfred (Bartsch, Turton).

Remarks. S. Afr. Mus. has 2 worn specimens (locality ?) identified by J. H. Ponsonby.

It is very unlikely that this species will prove to be either *Afrocominella* or *Burnupena*. There is no trace of a lip sinus, but the axial ribs and spiral lirae appear to number the same as in *Mangilia ponsonbyi* Sow.; the columella, however, is more curved in *angusta*, and without any trace of the 2 little pleats.

Gen. Euthria Gray

1850. Gray. *Figs. Moll. Anim.*, iv, p. 67.
1917. Cooke. *Proc. Mal. Soc.*, xii, p. 232 (radulae).
1918. Iredale. ibid., xiii, p. 34 (radula)
1929. Thiele. *Handbuch*, i, p. 312.

Remarks. The only South African species whose radula is known is *queketti*; but the figure published by Cooke is incorrect, being based on a mislabelled slide in the Gwatkin collection.

Several South African species have been referred to this genus, but have been transferred to other genera, or even families: *capensis* with syn. *lacertina* and *simonianus*, ? *magellani* and *turton* to *Afrocominella*; *eburnea*, *fuscotincta*, *ordinaria* to *Peristernia* (*Fasciolariidae*); *pura* to *Pyrene* (*Pyrenidae-Columbellidae*); *wahlbergi* to 'Purpura' (*Muricidae*); and *clathrata*, *fallax*, and *formosa* are juveniles placed in *Euthria* by Thiele (1925) with a query.

Key to the species

A. Whorls turreted, with a definite nodulose shoulder.
   1. Shoulder below middle of whorl. Protoconch diam. 1–1·2 mm. 1st whorl with 12 ribs, increasing to 18 nodules on last whorl . . . . *ponsonbyi*
   2. Shoulder at middle of whorl. Protoconch diam. 1·5 mm. 1st whorl with 16–17 ribs, decreasing to 11–13 nodules on last whorl . . . . *queketti*

B. Profile of whorls straight, without shoulder . . . . *filmerae*

Euthria ponsonbyi Sow.

Fig. 33

1889. Sowerby. *J. Conch.*, vi, p. 149, pl. 3, fig. 3.
1892. id. *Mar. Sh. S. Afr.*, p. 4, pl. 1, fig. 12.

Protoconch $2\frac{1}{2}$ whorls, diam. 1–1·2, alt. 0·8–1 mm. (relatively higher than in *queketti*), smooth. Postnatal whorls 7; 1st whorl with 12 ribs, often obscure, increasing regularly to 16 on 6th and 18 on last whorl, on the later whorls ceasing to be ribs and becoming merely nodules around the shoulder; crossed by fine spiral lirae on early whorls, traceable on later whorls between suture and the shoulder nodules, but becoming obliterated by the growth-lines; suture close under nodules, i.e. shoulder below middle of whorl, profile above shoulder concave; on base in juv. 7–8 feeble lirae with fine intermediaries, in older examples only a few barely traceable (Sowerby: 'subobsolete') grooves. Parietal callus obscurely dentiform, canal as long as rest of aperture, narrow, with feeble fold at base, recurved, outer lip internally smooth (Sowerby: 'subobsolete liratum'). 44 × 20 mm. (protoconch and outer lip broken, canal strongly reflexed so that its tip is not the most anterior part of the shell).

Operculum and radula unknown.

White, irregularly suffused with brown and with brown flames between the nodules.

Port Elizabeth (Sowerby); Port Alfred (Bartsch, Turton). St. Sebastian Bay, 27 fathoms, one juv.; off East London, 34 fathoms, one; off Umhlangakulu River (Natal), 50 fathoms, one (all dead) (S. Afr. Mus. P.F. coll.).

Remarks. The details of the sculpture on the early whorls distinguish this species from *queketti*, together with other characters. In Sowerby's figure the concavity of the profile above the shoulder nodules seems slightly exaggerated. The type was a worn specimen with incomplete canal.

The largest P.F. specimen was obtained in Natal waters; the juvenile, 18 mm. long, in St. Sebastian Bay.

Euthria queketti Smith

Figs. 31(*i*), (*j*), 33

1901. Smith. *J. Conch.*, x, p. 110, pl. 1, fig. 1.
Not 1917. Cooke. loc. cit., p. 234, fig. 7 (radula, err. = *Afrocominella*).

Protoconch 2½ whorls, diam. 1·5–1·75, alt. 1–1·25 mm. (relatively lower and broader than in *ponsonbyi*), smooth. Postnatal whorls 7; 1st whorl with 16–17 ribs, decreasing to 12 (11–13) on last whorl, but from about 3rd whorl onwards ceasing to be ribs, becoming nodules around the shoulder, increasing in prominence on later whorls; crossed by spiral lirae 4 on 1st whorl producing a clathrate sculpture, on 2nd only 2 lirae but numerous fine striae, which become very fine on 4th or 5th whorl and visible only above the shoulder, finally petering out, obscured by the growth-lines; base smooth, with growth-lines but only very faint indications of spiral lirae; shoulder at middle of whorl, profile above concave, below straight or slightly convex. Parietal callus dentiform, canal longer than rest of aperture, narrow, with nodule or angular ridge at its base, recurved, outer lip internally smooth. 55 × 24 mm. Smallest specimen seen 17·5 × 8·5 mm.

Operculum broadly oval, nucleus apical, incurved, 14 × 8 mm. in 55 mm. shell.

Creamy-white, irregularly suffused with brown, and with brown flames, shoulder nodules pale, operculum deep amber-brown.

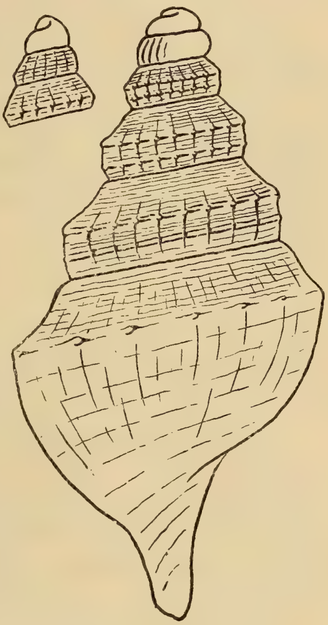


FIG. 33.
Euthria queketti Smith, juvenile 17·5 mm., with protoconch of *E. ponsonbyi* Sow. for comparison.

Radula with *c.* 160 rows, central plate triangular, length a little less than basal width, with 3 cusps, the middle one longer than its neighbours, lateralplate with outer cusp larger than the inner.

Off Durban, 40 fathoms [from fish stomachs] (Smith; also S. Afr. Mus. Ross-Frames coll.).

Off Umhlangakulu River (Natal), 50 fathoms, 1 dead, 1 living; off Umhloti River (Natal), 40 fathoms, 1 juv.; off Cone Point and off O'Neil Peak (Zululand), 34 and 55 fathoms, 1 each, dead; Algoa Bay, 25 fathoms, 1 living (S. Afr. Mus. P.F. coll.).

Remarks. The size and shape of the protoconch and the sculpture of the early whorls are important features distinguishing this species from *ponsonbyi*. Also, in *queketti* the ribs decrease in number, whereas in *ponsonbyi* they increase. Cooke's figure of a radula ascribed to *queketti* is due to some mistake; it is

certainly that of an *Afrocominella*. The true radula is very like that figured by Cooke for *E. cornea*, but with the central plate more like that figured for *linea*, and the lateral plate with a slightly larger outer cusp.

It is curious and suggestive that Thiele (loc. cit., p. 312) gave the distribution of *cornea* as 'Mittelmeer bis Südafrika'; I am not aware that *cornea* has ever been recorded from South Africa. Compared with a shell of *cornea* in S. Afr. Mus. (ident. Tomlin) *queketti* is broader and less fusiform owing to the stronger nodulose shoulder, and has a longer canal; but Smith (loc. cit., p. 111) said *queketti* was more 'slender'!

The presence of this species in Algoa Bay is rather unexpected; the P.F. specimen is the only one, dead or alive, known from west of Natal.

The juvenile, 17·5 × 8·5 mm. with protoconch and 4 whorls (fig. 33), appears at first sight very different from the adult, because the prominent nodules around the shoulder are developed only on the last two, or three, whorls. The size and squatness of the protoconch, and the sculpture of the early whorls agree exactly with older examples and leave no doubt as to its identity. There is just a hint on the back of the outer lip of the nodules to come.

Euthria filmerae Sow.

1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 1, pl. 1, fig. 3.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 54.

Profile of whorls straight, without shoulder. Protoconch 1½ whorls, diam. not quite 2 mm., smooth. Postnatal whorls 8; 1st whorl with 12–14 axial ribs, decreasing to 7 on last whorl; crossed by numerous spiral grooves, 4 on 1st whorl increasing to 11–13 on last whorl, 13–15 additional ones on base. Parietal callus nodiform, canal rather long, open, oblique, outer lip thin, internally smooth. 40 × 14 mm. (living); 47 × 16 mm.

Operculum unguiform, nucleus apical, incurved, 13·5 × 4 mm. in 40. mm. shell.

Lower part of body whorl below periphery white, rest of shell brown.

Dead: Pondoland (Sowerby, also S. Afr. Mus.); Port Alfred (Turton).

Off Itongazi River (Port Shepstone area, Natal), 24 fathoms, one living; off Amatikulu River (Zululand), 25 fathoms, one dead (S. Afr. Mus. P.F. coll.).

Remarks. The living and dead P.F. specimens both have a very thin shiny periostracum (like a coating of white-of-egg). The former retains the operculum, but most unfortunately the animal was not preserved.

Fam. *PYRENIDAE*

1902. Pace. *Proc. Mal. Soc.*, v, pp. 36–154 (*Columbellidae*, list of species).
1929. Thiele. *Handbuch*, i, p. 302 (*Columbellidae*).
1931. Tomlin. *Ann. Natal Mus.*, vi, p. 436.

Tomlin correctly takes the oldest genus to form the family name.

'. . . it is a matter of considerable difficulty to satisfactorily subdivide the

Columbellidae into genera and subgenera; and the difficulty has been much increased by the misdirected efforts of the mere conchologist . . . whatever value a section may have originally possessed, its true significance has in most cases been entirely lost sight of by subsequent authors, and species have been scattered about among the various genera and subgenera in an amazingly haphazard fashion' (Pace, p. 40). For example, *apicata* was put into *Nitidella* by Smith, but into *Alia* by Bartsch.

Thiele admits four genera, each with a distinctive radula. So far as is known the South Africa species fall into *Pyrene* and *Columbella*.

The lateral plate of the *Pyrene* radula is tricuspid: one cusp about midway on the plate, varying slightly according to the species (e.g. *filmerae*, *burnupi*, *albuginosa*, fig. 34), and separated by a varying distance from the two apical falcate cusps. In the available South African material the only radula of the *Columbella* form is that of *fulgurans*, the lateral plate of which is also tricuspid, but only the apical one is falcate, the other two being broad, like shark's teeth.

Species dealt with here, but whose radulae are unknown, are included in 'Columbella'.

The identification of the smaller species, e.g. Thiele's species from the *Valdivia* collection, is often difficult; and suggested synonymies are provisional.

Pyrene albuginosa (Rve.)

Fig. 34(*f*)

1859. Reeve. *Conch. Icon.*, sp. 223.
1921. Sowerby. *Proc. Mal. Soc.*, xiv, p. 126, fig. (*approximata*).
1926. Tomlin. *Ann. Natal Mus.*, v, p. 291, pl. 16, fig. 5 (*Mitrella natalensis*).
1931. id. ibid., vi, p. 436 (*Mitrella approximata*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 72 (var. *major*, nom. preocc.).
1933. id. *J. Conch.*, xix, p. 370 (nom. nov. var. *rietensis*).

Protoconch $2\frac{1}{2}$–3 whorls (junction with 1st postnatal whorl indistinct), alt. 0·75, diam. 0·5 mm., smooth. Postnatal whorls 7; no axial or spiral sculpture, except *c.* 10–11 lirae on lower half of base and rostrum. Outer lip thickened, *c.* 6 plicae within; columella with 4–6 granules. Periostracum thin, crinkly, scarious. $12 \times 4{\cdot}5$ mm.

Pale corneous, uniform, or mottled or reticulated with fawn or orange-brown, usually an interrupted subsutural band, and 2 spiral series (one peripheral, one infraperipheral) of opaque white spots enclosing between them a pale non-reticulate band; some specimens uniform with only a pale peripheral band. Periostracum usually pale, but sometimes amber-brown.

Radula with *c.* 225 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp rather strong.

False Bay to Algoa Bay, Port Alfred, East London, and Natal (auct. and S. Afr. Mus.). Natal (*natalensis*).

Off Cape Vidal (Zululand), 80–100 fathoms, one; off Morewood Cove, Tongaat, Umhloti, and Umhlanga (Natal), 22–36 fathoms, 14; off Umkomaas

River, 40 fathoms, 5 juv.; off East London, 20 fathoms, one; all dead but more or less fresh (S. Afr. Mus. P.F. coll.). 29° 38′ S. 31° E., 49 metres (U.C.T.).

Living: False Bay and East London (U.C.T.).

Remarks. The juveniles collected at Still Bay by Dr. Muir clearly show that *natalensis* is a synonym.

Specimens in S. Afr. Mus. labelled *albuginosa* and *floccata* Rve. do not seem very different, except the latter are larger and broader with less tapering spire, and are also more strongly marked with orange-brown blotches and reticulation; both show on the body-whorl 2 spiral series of opaque white spots, enclosing between them a pale non-reticulated band, also usually a series of white spots below the suture (on the upper whorls the peripheral spots just show above the suture of following whorl). Some specimens have more or less regularly spaced, straight or crinkly, axial bars between suture and periphery; some are orange-brown with a pale peripheral band, others uniform orange-brown. Von Martens (1903. *D. Tiefsee Exp.*, vii, pp. 56, 106) mentions uniform 'scarlet-red' examples of *floccata* from Pondoland; and a beach example from Natal in S. Afr. Mus. is reticulate with brown, but has the peripheral band bright pink.

The same mottled and reticulate pattern is found in *C. seychellarum* von Martens (loc. cit., p. 105, pl. 5, fig. 17) which, however, is an even more broadly oval shell than *floccata*.

Fig. 34.

Protoconchs of (*a*) *Pyrene kraussii* (Sow.); (*b*) *P. burnupi* (Smith); (*c*) *P. dianae* (Thiele); (*d*) 'Columbella' *hella* Thiele. Central and lateral radula plates of (*e*) *P. burnupi* (Smith); (*f*) *P. albuginosa* (Rve.), lateral plate only; (*g*) *P. filmerae* (Sow.), lateral plate only; (*h*) *Columbella fulgurans* Lam.

A comparison with *apicata* Smith is also not irrelevant. The colour-pattern is very similar, and although the colour is never such a deep brown as in *apicata*, living and fresh *albuginosa* often show a very clear pale brown mottling. *P. albuginosa*, however, does not have a bulbous protoconch, and I have not seen a trace of spiral striae on the last whorl in any specimen.

Pyrene filmerae (Sow.)

Fig. 34(*g*)

1892. Sowerby. *Mar. Sh. S. Afr.*, p. 21 (*sagena*, non Rve.).
1900. id. *Proc. Mal. Soc.*, iv, p. 3, pl. 1, fig. 8.

Protoconch 2 whorls, alt. and diam. 0·8–0·9 mm., smooth, slightly lop-sided. Periostracum forming a crinkled and scarious band below the suture, giving a somewhat coronate or turreted appearance to the spire.

The characteristic (as Sowerby said; but see also *splendidula* Sow.) dark brown band against (below) the suture is usually interrupted by white spots, which may be so large as to disrupt the band into a series of alternating brown and white areas; this is particularly noticeable in the Natal shells, some of which also show triangular brown marks on a white ground instead of the more usual white spots on a brown ground. The dark sutural band is not very obvious in the fresh specimen from Durnford Point, which is cream with, on the body-whorl, a peripheral series of orange-brown spots through which runs a continuous thin white line, a less distinct series of spots on middle of base, protoconch pinkish.

Aperture in living examples violaceous. Periostracum dull brown, obscuring the bright pattern seen in beach examples; in the Durnford Point example pale amber.

Radula with *c.* 200 rows, central plate very delicate, lateral plate apically bifalcate, the proximal cusp small.

Port Elizabeth and Pondoland (Sowerby). Port St. Johns, and Natal (between Durban and Port Shepstone) (S. Afr. Mus.).

Off Durnford Point (Zululand), 13 fathoms, 3 dead, but one with periostracum (S. Afr. Mus. P.F. coll.).

Living: Umgazana (south of Port St. Johns), littoral (U.C.T.).

Remarks. Turton obtained no examples at Port Alfred, and consequently one suspects that the Bairstow and Filmer shells originally came from farther north.

The scarious band of the periostracum is seen in the Umgazana shell, but is more strongly developed in the fresh specimen from Durnford Point. The latter was identified by Sowerby (3rd) as 'probably *splendidula*' (see Sowerby: 1847. *Thes. Conch.*, i, Columbella, pl. 37, figs. 65, 66). If he had seen the other two shells from the same haul, which are obviously worn *filmerae*, he might not have suggested the Philippine *splendidula*.

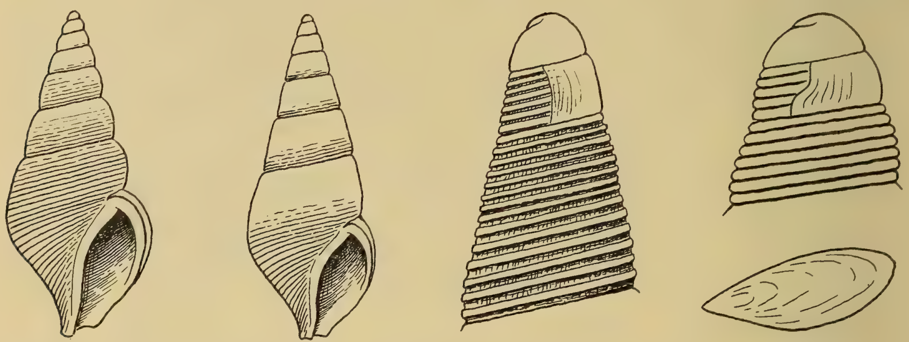
Some specimens are very similar in pattern to the illustration of *tringa* Sow. (loc. cit., pl. 37, fig. 62).

Pyrene pura (von Martens)

Fig. 35(*a*)

1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 25, pl. 2, fig. 14 (*Euthria p.*).
1925. Thiele. ibid., xvii, p. 173, pl. 30 (18), fig. 21 (*Columbella helena*).
1925. id. ibid., p. 180 (*Euthria p.*).

Protoconch 2 whorls, alt. and diam. 1 mm., smooth (but all specimens worn). Postnatal whorls 5; spire subtending an angle of 35°, profile of whorls gently convex. Growth-lines but no axial sculpture. Fine spiral striae over the greater part of whorl, but (in the present more or less corroded specimens) variable, when traceable *c.* 8 on 3rd whorl, increasing to *c.* 12 on 5th; additional striae on base *c.* 20 (scarcely traceable on rostrum). Outer lip thickened. Periostracum thin. 14 × 6 mm.; 17 × 7·5 mm.



a *b* *c* *d*

Fig. 35.

(*a*) *Pyrene pura* (von Martens). (*b*) *P. parhelena* n. sp. (*c*) 'Columbella' *polyarosus* n. sp., apex. (*d*) 'Columbella' *confertilirata* n. sp., apex and operculum.

White; two shells with very faint indications of subsutural brown spots and even fainter peripheral marks. Periostracum pale buff or yellowish.

Radula with *c.* 200 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp moderately strong, separated rather widely from the apical cusps.

34° 31′ S. 23° 2′ E., 500 metres (von Martens: one); 35° 16′ S. 22° 26′ E., 155 metres (Thiele: one *pura*, 2 *helena*).

Cape Point NE. ¼ N. 18 miles, 135 fathoms, one living; Vasco da Gama Peak N. 71° E. 18 miles, 230 fathoms, one dead; Lion's Head N. 67° E. 25 miles, 131–136 fathoms, 2 dead; 10 dead without precise locality (S. Afr. Mus. P.F. coll.).

Remarks. These shells are clearly referable to von Martens's species. Thiele separated as *helena* two out of three shells taken in the same locality, seemingly because these two showed spiral striae only on the lower part of the whorl. His figure of *helena* resembles that of *pura* in shape.

Pyrene parhelena n. sp.

Fig. 35(*b*)

Protoconch 2 whorls, alt. 1·25, diam. 1 mm., smooth, junction with 1st postnatal whorl distinct. Postnatal whorls 5; spire subtending an angle of 30°, profile of whorls nearly straight; growth-lines but no axial sculpture. Extremely fine spiral striae over whole whorl, from 3rd whorl stronger striae appear on lower half of each whorl, 4–5 on 3rd whorl, increasing to 6–7 on 5th; additional striae on base *c.* 20. Outer lip thickened submarginally. Periostracum thin. 14 × 5 mm.

Pale fawn with faint white spots; periostracum pale.

Radula with *c.* 200 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp moderately strong, well separated from apical cusps.

Cape St. Francis NE. × E. ½ E. 36 miles, 70 fathoms, one dead; Cape St. Blaize N. × E. 73 miles, 125 fathoms, one living, 3 dead (S. Afr. Mus. A8869, A8870 (Type). P.F. coll.).

Remarks. Similar in shape to *barbara* Thiele 1925, but with different sculpture; sculpture similar to that of *helena*, but shape different.

Pyrene kraussii (Sow.)

Fig. 34(*a*)

1844. Sowerby. *Proc. Zool. Soc. Lond.*, p. 53 (*Columbella k.*).
1847. id. *Thes. Conch.*, i, Columbella, sp. 99, p. 144, pl. 40, figs. 180, 181.
1848. Krauss. *Südafrik. Moll.*, p. 109, pl. 6, fig. 11 (*Mangelia fulgurans*).
1848. id. ibid., p. 122, pl. 6, fig. 17 (*cereale* Menke in litt.).
1860. Gould. *Proc. Bost. Soc. Nat. Hist.*, vii, p. 334 (*fulminea*).
1894. Sowerby. *J. Conch.*, vii, p. 7 (*kitchingi*).
1897. id. *Append. Mar. Sh. S. Afr.*, p. 10, pl 6, fig. 3 (*kitchingi*).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 56, pl. 37, fig. 5 (*alfredensis*).
1931. Tomlin. *Ann. Natal Mus.*, vi, p. 436.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 70, pl. 17, no. 500 (var. *albanyana*).
1932. id. ibid., p. 70, pl. 17, no. 504 (*helena*, non Thiele).

Protoconch 2½–3 whorls, alt. and diam. 0·5 mm., smooth, last whorl feebly keeled, with minute spiral striae below the keel (seen only in unworn examples), the keel runs down obliquely at junction with 1st postnatal whorl. Postnatal whorls 4–5; axial ribs 10 on each whorl.

Radula with 110–150 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp rather strong (cf. *albuginosa*). (*kraussii* and *kitchingi* forms examined.)

Table Bay, and False Bay to Durban and Tongaat (S. Afr. Mus.). Off East London, 32 fathoms (S. Afr. Mus. P.F. coll.).

Living: Port Nolloth, Langebaan (Saldanha Bay), False Bay, and Knysna (U.C.T.).

Remarks. Sowerby (1892, p. 4) doubted whether *fulgurans* was a Pleurotomid, and Turton (1932) listed it definitely as a *Columbella*, probably after con-

sultation with Tomlin. I have seen examples from Knysna (Krauss's type locality), including plump (*kraussii*) and slender (*fulgurans*) forms.

Turton's name *helena* is preoccupied by Thiele, but the two are quite different species (cf. *pura*). Turton said his *helena* had no zigzag lines, but his photograph shows them.

Although the characteristic zigzag lines are usually present and easily visible, in some specimens they are obscured by a uniform chestnut-brown coloration, with sometimes a series of pale spots below the suture and another below the periphery (*kitchingi*).

The Durban specimens, taken alive by Burnup, are more delicate and translucent than specimens from other parts of the coast, especially the uniform brown *kitchingi* form from False Bay and the west coast.

aberr. *io* Bartsch

1915. Bartsch. loc. cit., p. 57, pl. 37, fig. 4.
1931. Tomlin. loc. cit., p. 436 (as *kraussii* aberr.).

Tomlin regarded *io* as an abnormal *kraussii*. It is more slender even than the *fulgurans* form. Although I have seen no similar aberration among the numerous examples from False Bay and Still Bay, there is one specimen taken together with two *kraussii* at Tongaat which agrees with Bartsch's description and figure.

Protoconch 2 whorls (but worn), diam. 0·5 mm., smooth. Postnatal whorls 5; 1st whorl worn, 2nd and 3rd each with 10 axial ribs, but evanescent towards end of 3rd whorl, protractive as in *kraussii* (Bartsch said retractive, but see his figure), obsolete on 4th and 5th whorls. 7 × 2·5 mm.

Translucent, with orange-brown zigzag axial lines.

Port Alfred (Bartsch; one specimen; Turton: 'rare'). Tongaat (Natal), one specimen (S. Afr. Mus.).

Pyrene burnupi (Smith)

Fig. 34(*b*), (*e*)

1901. Smith. *J. Conch.*, x, p. 112, pl. 1, fig. 2 (*Columbella b.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 67, pl. 16, no. 488 (*Columbella kowiensis*).

Protoconch 3 whorls, alt. 0·6, diam. 0·5 mm., smooth, last whorl with feeble peripheral keel which runs down obliquely at junction with 1st postnatal whorl. Postnatal whorls 3–4; axial ribs 12–13 on 1st whorl, 13–14 (15) on 2nd–4th; crossed by spiral lirae 4 on 1st whorl, 5 on 2nd, 6–7 on 3rd and 7–8 on 4th, additional lirae on base 9–10; intersections forming rounded granules or beads. 4·5 × 1·5–1·75 mm.

Translucent yellowish, 3–4 red-brown interrupted lines (on the spiral lirae) around middle of whorl, lower part of base also with dark lines or spots.

Radula with *c.* 200 rows, central plate delicate, lateral plate apically bifalcate, proximal cusp well separated from the apical cusp.

Natal (Smith); Port Alfred (Turton).

Living: Durban and Scottburgh (S. Afr. Mus. coll. Burnup).

Pyrene langleyi (Sow.)

1897. Sowerby. *Append. Mar. Sh. S. Afr.*, p. 10, pl. 8, figs. 8, 9 (*Columbella l.*).

Protoconch 2 whorls, alt. 0·6, diam. 0·5 mm., smooth. Postnatal whorls 4 (*natalensis*: 5); growth-lines but no axial ribs, occasionally a thickened growth-line simulates a rib; no spiral sculpture except some (*c.* 10) obscure striae on base. 4·5 × 2 mm.

Corneous-brown, uniform or with 2 series of white spots, one infrasutural, one from top of aperture.

Radula with *c.* 200 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp strong, well separated from apical cusps (cf. *burnupi*).

Port Elizabeth (Sowerby); Port Alfred (Turton); Kalk Bay and Buffels Bay (False Bay) (S. Afr. Mus.).

Living: False Bay (U.C.T.).

Pyrene lightfooti (Smith)

1901. Smith. *J. Conch.*, x, p. 112, pl. 1, fig. 3 (*Columbella l.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 67, pl. 16, no. 487 (var. *assimilans*).

Protoconch 2 whorls, alt. and diam. 0·8 mm., smooth, junction with 1st postnatal whorl distinct. Postnatal whorls 3. Axial ribs, when present, *c.* 15 on 1st whorl, *c.* 17 on 2nd, *c.* 17–19 on 3rd; crossed by spiral lirae 7 on 1st whorl, 8 on 2nd, 9–10 on 3rd, additional lirae on base 18–20; lirae flattened, broader than the sulci. 7 × 3 mm.; plump example 6 × 3, slender 6·5 × 2·5 mm.

Living: yellowish, each lira castaneous brown, including those on base, seldom interrupted, a series of pale subsutural spots. Beach examples: pale buff, 5–7 orange-brown interrupted lines (on the lirae), the interruptions occurring so as to delimit a series of oblong brown patches; base also with brown lines.

Radula with *c.* 150 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp strong, separated from the apical cusps but not so distant as in *burnupi*.

Kalk Bay (False Bay) (Smith, and S. Afr. Mus.); Port Alfred (Turton). Off East London, 22 fathoms, 3 dead (S. Afr. Mus. P.F. coll.).

Living: Algoa Bay, 60 fathoms (U.C.T.).

Remarks. If the condition of the type (types) in British Museum was no better than that of the cotypes in S. Afr. Mus., it is not surprising that Smith's description did not mention the axial ribs. They are, however, very low and rounded, and though usually developed on 1st and 2nd whorls, are frequently obsolete on the 3rd.

R. M. Lightfoot of the South African Museum found several dead specimens at Kalk Bay, but the species has not been found living in False Bay by U.C.T. There are no specimens in the Muir collection from Still Bay.

Pyrene atrata (Gould)

1903. Smith. *Proc. Mal. Soc.*, v, p. 374 (*Columbella a.*).
1910. Schwarz. *Tr. Geol. Soc. S. Afr.*, xii, p. 115.

Radula (Durban specimen) with *c.* 150 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp strong, well separated from the apical cusps.

Fossil: Pleistocene, Port Elizabeth (Schwarz).

Living: Durban (Smith). Morrumbene estuary, Inhambane, and Maxixe, Portuguese East Africa (U.C.T.).

One of the Inhambane specimens, 3·3 × 1·75 mm., resembles very closely the figure of *padangensis* Thiele (1925. *D. Tiefsee Exp.* xvii, p. 327, pl. 31 (19), fig. 19) both in form and coloration.

P. atrata occurs in several forms in the Indo-Pacific region.

Pyrene dianae (Thiele)
Fig. 34(*c*)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 176, pl. 31 (19), fig. 13 (*Columbella d.*).

Protoconch 1½ whorls, alt. and diam. 0·75 mm., smooth, junction with 1st postnatal whorl distinct. Postnatal whorls 3–3½; axial ribs on 2nd whorl *c.* 22–24, on 3rd *c.* 28–30; spiral lirae 6 on 1st whorl, 8 on 2nd, 10 on 3rd; additional lirae on base *c.* 18. 5 × 2 mm.; Thiele: 4·5 × 1·8 mm.

Radula with *c.* 200 rows, central plate very delicate, lateral plate apically bifalcate, proximal cusp strong, well separated from the apical cusps.

34° 51′ S. 19° 37′ E., 80 metres, one (Thiele).

Off Cape St. Blaize, 125 fathoms, one (S. Afr. Mus. P.F. coll.).

Living: 34° 18′ S. 18° 30′ E. (False Bay), 51 metres (U.C.T.).

Columbella fulgurans Lam.
Fig. 34(*h*)

1822. Lamarck. *Anim. sans Vert.*, vii, p. 296.
1859. Chenu. *Man. Conchyl.*, i, fig. 1076.

Radula with 130–140 rows, central plate wide, arcuate, lateral plate tricuspid, the proximal cusp the largest, the apical one falcate.

Living: Mozambique Island (U.W.).

'Columbella' *pyramidalis* Sow.

1894. Sowerby. *J. Conch.*, vii, p. 370.
1897. id. *Append. Mar. Sh. S. Afr.*, p. 10, pl. 6, fig. 4.
1904. Smith. *J. Malac.*, xi, p. 22 (*adjacens* n. sp., listed, sine descr.).

1931. Tomlin. *Ann. Natal Mus.*, vi, p. 437.
1932. Turton. *Mar. Sh. Pt. Alfred*, pp. 70, 71 (*pyramidalis* and var. *fusca*).
1932. id. ibid., p. 71, pl. 17, no. 509 (*adjacens*), and pl. 17, no. 510 (*distincta*).

Port Elizabeth and Port Alfred.

Off Cove Rock and East London, 22–32 fathoms (S. Afr. Mus. P.F. coll.).

'Columbella' *eulimoides* Turton

1932. Turton. *Mar. Sh. Pt. Alfred*, p. 71, pl. 17, no. 511.

Two dead specimens (one very worn) appear referable to this species and confirm its validity. They are more slender than *pyramidalis*, with a longer base and rostrum. The larger measures 8 × 2·5 mm., with 5 postnatal whorls. The nuclear apex (? if this is the actual nucleus) alt. 0·4, diam. 0·6 mm.

Off Keiskamma River, 33 fathoms (S. Afr. Mus. P.F. coll.).

'Columbella' *apicata* Smith

1899. Smith. *J. Conch.*, ix, p. 247, pl. 5, fig. 2.
1932. Turton. *Mar. Sh. Pt. Alfred.*, p. 71, pl. 17, no. 520 (*rufanensis*); and p. 73, pl. 17, no. 526 (*arcuata*).

Although the general colour pattern is the same as in *filmerae*, the spire is longer and the whorls do not widen so rapidly; in *filmerae* the whorls are much broader and appear as if telescoped.

Three topotypes (S. Afr. Mus. coll. Burnup) lack the distinctive protoconchs; they show on the body-whorl 5–6 fine spiral striae, not mentioned in Smith's description, which said only the base was striate. cf. *Alcira elegans*.

Durban (Smith); Port Alfred (Bartsch, Turton).

Two specimens from Delagoa Bay (U.W.), 9·5 × 3·5 mm. (protoconchs missing) may be this species. Outer lip thickened, plicate within.

One of these shells has the *filmerae* colour pattern, but the other has numerous close-set narrow, straight or slightly crinkly axial stripes, brown on a yellowish ground, about 30 on the body-whorl (cf. *cincinnata* von Martens, 1880. *Mauritius & Seychellen*, p. 248, pl. 20, fig. 14). Margin of outer lip and canal of both shells chestnut-brown.

'Columbella' *mutabilis* Turton

Smith: *lightfooti* var., ined. specimens at Brit. Mus.

1932. Turton. *Mar. Sh. Pt. Alfred*, p. 68, and vars. *multicostata* and *convexa*, pl. 16, nos, 489, 490, 491.

Protoconch 2 whorls, alt. 0·75, diam. 0·5–0·6 mm., smooth, junction with 1st postnatal whorl distinct. Postnatal whorls 4; axial ribs 11–12 on 1st whorl, increasing to 13–14 (15) on last whorl; crossed by spiral lirae 5 on 1st whorl, 6 on 2nd, 7 on 3rd, 7–8 on 4th, additional lirae on base 10–12. 7 × 2·75 mm. Buff or fulvous.

Port Alfred (Turton); False Bay and Still Bay (S. Afr. Mus.).

Off Cove Rock and East London, 27–32 fathoms, 4 dead (S. Afr. Mus. P.F. coll.).

Remarks. Turton's var. *convexa* does not seem worth maintaining, but if *multicostata* is retained it must be renamed (preocc. Blankenh. 1901). This may be a composite species, but further and better material is required. If Turton had given an illustration of *consanguinea* Sow. 1897 (included in *Mangilia* by Bartsch and Turton) a comparison with *mutabilis* might have been possible; there seems to be some resemblance, as far as one can judge from Sowerby's figures.

'Columbella' *polyarosus* n. sp.

Fig. 35(*c*)

Protoconch 2 whorls, alt. 1·5, diam. 1·3 mm., smooth, with faint axial pliculae prior to junction with 1st postnatal whorl. Postnatal whorls (largest specimen) $5\frac{1}{2}$; spire subtending an angle of 30°, profile almost straight in early whorls, becoming gently convex later. No axial sculpture, but growth-lines distinct in the spiral sulci, less distinct across the lirae. Spiral lirae 7 on 1st–3rd whorls, 8 on 4th and 5th, additional lirae on base (of 3rd whorl) *c.* 20. Lirae flattened, subequal in width to the sulci. Columella slightly curved. Protoconch plus 3 whorls 11 × 3·75 mm., protoconch plus 5 whorls 22 × (approx.) 7 mm. (Type.)

Cream or buff, the largest specimen with faint orange-brown axial flames.

Off Cape Vidal (Zululand), 80–100 fathoms, one apex; off O'Neill Peak (Zululand), 90 fathoms, one with 3 whorls; off Cape Natal, 54 fathoms, one 22 mm. specimen, but last whorl broken; off Umhloti River, 40 fathoms, one (3 whorls) and 3 fragments; off Hood Point (East London), 49 fathoms, one (2 whorls); off Cape St. Blaize, 125 fathoms, fragment of apex; all dead (S. Afr. Mus. A8875–78, and A8882. Type A8875. P.F. coll.).

Remarks. Has the appearance of a very large *Daphnella sulcata*, with larger protoconch and less deep sutures. The aperture is Columbellid, not like that of *Daphnella*.

'Columbella' *confertilirata* n. sp.

Fig. 35(*d*)

Fusiform. Protoconch 2 whorls, alt. 1, diam. 1·25 mm., smooth, faint axial pliculae prior to the sigmoid junction with 1st postnatal whorl. Postnatal whorls 4, spire subtending an angle of *c.* 35°, profile of whorls gently convex. Growth-lines but no axial sculpture; spiral lirae 5 on 1st whorl, 7 on 2nd and 3rd, 8 on 4th, additional lirae on base *c.* 14; lirae rounded, wider than the sulci. Columella nearly straight. 11 × 4·5 mm.

Operculum narrow ovate, nucleus apical, 2·75 × 1 mm.

Cream or buff, with very faint indications of orange marks; operculum dark brown.

Off Umkomaas River (Natal), 40 fathoms, 2, 2 juv., and fragments (S. Afr. Mus. A8879. P.F. coll.).

Remarks. The shape is similar to that of *Mitromorpha volva*. The two larger specimens have 4 whorls, but some of the fragments indicate that 5-whorled examples with a width of 6 mm. occur.

'Columbella' *adela* Thiele

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 174, pl. 30 (18), fig. 24.

Four white specimens from Still Bay (Muir coll.) agree with Thiele's description and figure.

34° 51′ S. 19° 37′ E. 80 metres (Thiele). Thiele recorded it also from Great Fish Bay, Angola.

It may be compared with *kincaidi* Tomlin 1926, which is yellowish, and *amphitrite* Turton 1932, which is brown.

'Columbella' *meta* Thiele

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 175, pl. 31 (19), fig. 3.
1925. id. ibid., p. 175, pl. 31 (19), fig. 12 (*veneris*).

Two dead specimens may be referable to *meta*, though not quite so slender: 6 × 2 mm. as against 7·5 × 2·4 mm.; and with only 5 spiral lirae on 3rd and 4th whorls compared with 6–7 (if Thiele's figure is exact in this detail).

35° 16′ S. 22° 26′ E. 155 metres (Thiele); 34° 51′ S. 19° 37′ E., 80 metres (Thiele: *veneris*).

34° 26′ S. 25° 42′ E. 124 fathoms, one; Cape St. Blaize N. × E. 73 miles, 125 fathoms, one (S. Afr. Mus. A8569 and A8881. P.F. coll.).

C. veneris would seem to be extremely close, if not synonymous.

'Columbella' *brunnescens* Thiele

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 175, pl. 31 (19), fig. 2.

Two specimens seem referable to this species, 4·5 × 2 mm. and 5·3 × 2·2 mm.

34° 8′ S. 24° 59′ E. 80 metres; and 33° 50′ S. 25° 48′ E. (depth not recorded) (Thiele).

Off Cape Recife, 56 fathoms; off Cape St. Blaize, 39 fathoms (S. Afr. Mus. A8580, A8581. P.F. coll.).

'Columbella' *hella* Thiele

Fig. 34(*d*)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 176, pl. 31 (19), fig. 5.
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 74, pl. 17, no. 531 (*brunescens* [*sic*], non Thiele).

Protoconch $1\frac{1}{2}$ whorls, alt. and diam. 0·5 mm., smooth, junction with 1st postnatal whorl distinct. Postnatal whorls $4-4\frac{1}{2}$; spiral lirae 6–7 on 1st and 2nd whorls, 7–8 on 3rd, 8–9 (10) on 4th, additional lirae on base *c.* 15; lirae flattened, wider than the sulci. 6×2 mm.; Thiele: $6{\cdot}5 \times 2{\cdot}25$ mm.

Buff or fawn, protoconch glossy brown; the Natal specimen is glossy cream (presumably fresher than the others).

35° 16′ S. 22° 26′ E., 155 metres, one (Thiele). Port Alfred, two (Turton).

Off Illovo River (Natal), 27–30 fathoms, one; off East London, 32 fathoms, 12; off Nieca River (East London area), 43 fathoms, 2; off Keiskamma River, 33 fathoms, one; off Great Fish Point, 51 fathoms, one; 34° 5′ S. 25° 55′ E., 67 fathoms, 6; all dead (S. Afr. Mus. P.F. coll.).

Remarks. Fortunately Turton's *brunescens* [*sic*] seems to be the same as *hella*, otherwise it would require a new name.

'Columbella' *vitula* n. sp.

Fig. 36(*a*)

Juv. Protoconch $1\frac{1}{2}$ whorls, alt. 0·5, diam. 0·6 mm., smooth, a few fine pliculae prior to the indistinct junction with 1st postnatal whorl. Postnatal whorls $2\frac{1}{2}$; axial ribs *c.* 20–22 on each whorl, slightly protractive, evanescent on base, tops of ribs forming granules separated by a spiral groove; crossed by spiral lirae 4 on 1st whorl, 5 on 2nd, more distinct in the intervals between the ribs, additional lirae *c.* 12 on base (obscure on rostrum). $3{\cdot}5 \times 2$ mm. Pale buff.

Off Cove Rock (East London), 80–130 fathoms, one juv. (S. Afr. Mus. A8887. P.F. coll.).

Remarks. Although only a juvenile, the sculpture seems distinct and recognizable enough to justify a specific name, suggested by proximity to the Buffalo River at East London.

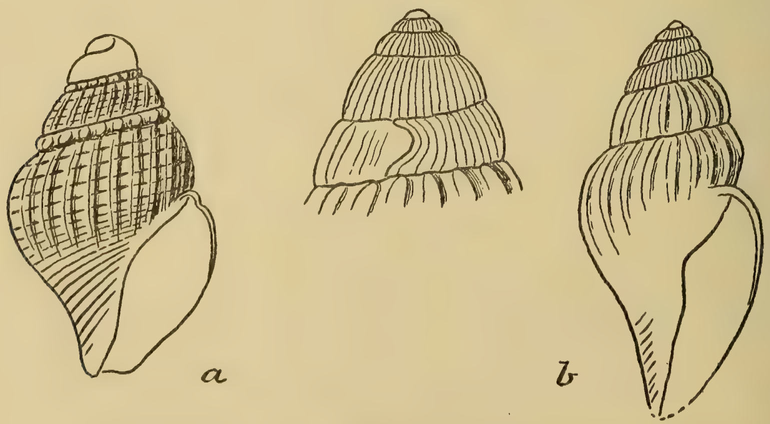


Fig. 36.
(*a*) 'Columbella' *vitula* n. sp. (*b*) 'Columbella' *sigma* n. sp., with protoconch further enlarged.

Resembles *C. chuni* Thiele (1925. *D. Tiefsee Exp.*, xvii, p. 176, pl. 31 (19), fig. 6) from the Zanzibar area, 404–463 metres, in having a subsutural groove interrupting the ribs, but has more ribs.

Thiele's description of the radula indicates that *chuni* is a *Pyrene*; the present species probably also belongs to this genus.

'Columbella' *sigma* n. sp.

Fig. 36(*b*)

Protoconch 5 whorls, alt. and diam. 0·75 mm., nucleus smooth, whorls with close-set pliculae, junction with 1st postnatal whorl strongly sigmoid. Postnatal whorls 2½, profile convex, very slightly shouldered; axial ribs 14 on 1st whorl, 15 on 2nd, 8 on the last half whorl, from suture to suture, evanescent on base of body-whorl. No spiral sculpture except about 8 lirae on lower part of base and rostrum (the tip of the rostrum seems to be worn). Columella slightly angular at midway. 4 × 2 mm.

Pale corneous, an opaque white band around shoulder and a disconnected series of small white streaks from top of aperture, protoconch fawn.

Off Cove Rock (East London area), 22 fathoms, one (S. Afr. Mus. A8890. P.F. coll.).

Remarks. Among the known protoconchs of South African species this seems quite distinctive. Perhaps not a Columbellid.

Fam. *RAPIDAE*

1929. Thiele. *Handbuch*, i, p. 300 (*Magilidae*).

The family is characterized, as far as is known, by the absence of a radula.

Although Thiele adopted the family name *Magilidae* in place of *Coralliophilidae*, the oldest genus is *Rapa* Montfort 1810.

Gen. Latiaxis Swainson

1935. Tomlin. *J. Conch.*, xx, pp. 180–3 (list of Recent species).

Rapana fritschi von Martens was included in *Latiaxis* by Tomlin (1923, 1935). Owing to a mistaken identity I removed it to *Tritonalia* (*Muricidae*) (1957), but now return it to the present family in the genus *Coralliophila* (*v. infra*).

Smith considered that his *Latiaxis rosaceus* (1903) might, conchologically, equally well be put into *Coralliophila*, but I leave it where Smith originally put it.

No further examples of *L. tortilis* or *L. capensis* Tomlin 1928 have been found in the P.F. bottom samples recently examined, but the search was rewarded by one example of a remarkable species which appears to be new.

Latiaxis rosaceus Smith

1892. Sowerby. *Mar. Sh. S. Afr.*, p. 16 (*nodosus*, non Adams).
1903. Smith. *Proc. Mal. Soc.*, v, p. 376, pl. 15, fig. 16.
1923. Tomlin. *J. Conch.*, xvii, p. 46 (as syn. of *fritschi*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 78.
1935. Tomlin. loc. cit., p. 183 (as syn. of *fritschi*).

Aperture (incl. canal) about 1⅓ times spire. Protoconch 2 whorls, alt. 1, diam. 1·3 mm., smooth. Postnatal whorls 4, profile angularly shouldered at (or slightly below) middle of whorl. Axial ribs 10 on 1st and 2nd whorls, 10–9 on 3rd and 4th, sometimes only 8 on 4th, usually prominent; spiral lirae 4 on 1st whorl, 6 on 2nd, increasing to 9–10 on 4th, 8–9 additional lirae on base, with intermediaries; main lirae and intermediaries strongly and closely squamulose (also the interstices when visible). Rostrum umbilicate and costate, columella slightly curved, anteriorly with free edge slightly reflexed over umbilicus. Aperture angularly piriform, posterior margin of outer lip oblique to preceding whorl. 18 × 13 mm. Smith: 21 × 13 mm.

Operculum and animal unknown.

Grey, aperture pale violaceous. Beach specimens rose-pink, salmon, or white.

Port Elizabeth, Port Alfred (Smith, Turton); Still Bay and Port Alfred (S. Afr. Mus.).

Off Durnford Point (Zululand), 13 fathoms, one dead but fresh (S. Afr. Mus. P.F. coll.).

Remarks. The above description is from the fresh P.F. specimen measuring 15·5 × 10 mm. This was seen by Tomlin and identified as *fritschi*. Tomlin did not regard *rosaceus* as a distinct species in spite of Smith saying that 'rubro-coccinea' [= *fritschi*] should not be confused with *rosaceus* on account of the difference in shape.

In the Muir collection from Still Bay there are a few specimens whose squat shape and shouldered whorls at once distinguish them from *fritschi*. Approximately equal-sized shells measure: *rosaceus* 15·5 × 11 mm. compared with *fritschi* 16 × 9 mm. I have seen no intergrading examples, and therefore maintain Smith's species.

Latiaxis tortilis H. & A. Adams

Fig. 38(*a*)

1864. H. & A. Adams. *Proc. Zool. Soc. Lond.* (for 1863), p. 431.
1882. Sowerby. *Thes. Conch.*, v, p. 424, fig. 1 (not the Type, see Smith, 1906).
1903. id. *Mar. Invest. S. Afr.*, ii, p. 228.
1906. Smith. *Ann. Natal Mus.*, i, p. 39.
1935. Tomlin. loc. cit., p. 183 (= *gyratus* Hinds 1844).
1942. Yen. *Proc. Mal. Soc.*, xxiv, p. 225.

Spire less than aperture (allowing for the missing protoconch about 1¼ times in aperture). Postnatal whorls 5; spire turreted, profile of whorls

angularly shouldered. Sutures undulate. Axial ribs on 1st whorl 9 (somewhat worn), and 2nd and 3rd whorls 9, on 4th 10, on 5th 10 and 11 irregular and interrupted by an injury, broad and rounded, from suture to suture, petering out on base, shoulder keel in apical view undulate; crossed by a strong peripheral keel forming the shoulder, becoming prominent and somewhat laminar and upturned on last whorl at intersections with the ribs; spiral lirae above shoulder keel on 1st and 2nd whorls worn, below shoulder on 1st whorl 2, on 2nd 2–3, on 3rd 4–5 above and 4–5 below, on 4th 6–7 above and 6–7 (8) below, on 5th 8 above and 8–9 below; 20 additional lirae on base; lirae on body-whorl subequal; all lirae closely squamulose. Rostrum costate, with 6–7 squamae. Umbilicus narrow. Aperture plicate within. 43 × 25 mm. (28 incl. shoulder projections). Diameter of broken surface at apex 1·5 mm.

Dirty white, aperture pure white.

Vasco da Gama Peak (Cape Point) S. 75° E., distant 13½ miles, 166 fathoms (Sowerby, 1903) (S. Afr. Mus. A4950. P.F. coll.).

Remarks. The single specimen obtained by the *Pieter Faure* is here described and figured; Sowerby only recorded it.

Sowerby identified it with the Chinese *tortilis*; it was seen by Tomlin, who, however, made no comment on it when he described *L. capensis* (1928. *Ann. S. Afr. Mus.*, xxv, p. 332).

The specific status of *tortilis* seems to be not satisfactorily decided. Sowerby disagreed with Gray in making it a synonym of *idoleum* Jonas; Smith agreed with Gray. Tomlin makes both *idoleum* and *tortilis* synonyms of *gyratus* Hinds 1844; Yen keeps *tortilis* and *gyratus* separate.

The Type of *tortilis* is in the British Museum (Cuming coll.); the original authors stated it had 6 whorls, but gave no size; Yen said it had 7 whorls and measured 38·5 × 25·4 mm., adding that *gyratus* (Type also in B.M.) was a smaller species. The latter statement seems correct: Hinds's figure shows 6 whorls, including protoconch, and measures only 19 mm. long (assuming his figure is natural size). Unfortunately Yen did not figure the two species.

The present specimen with 5 whorls (it is unlikely that another postnatal whorl as well as the protoconch is missing) is larger than the Type of *tortilis*. In the original description the spire was said to equal the aperture; here the aperture is distinctly longer than the spire.

But the present specimen agrees with *tortilis* in having axial ribs ('plicis undulatis distantibus') whereas according to Hinds's description and figure ribs are completely absent in *gyratus*. I prefer, therefore, to follow Yen in recognizing two species, and agree with Sowerby in assigning the present specimen to *tortilis*.

Apart from the specific identity of this specimen, considerable interest attaches to its alleged provenance. Both *gyratus* and *tortilis* were recorded from the East (Macassar Straits and China). A locality on the slope of the continental shelf *west of Cape Point* is indeed surprising.

The labelling of the catches on board the *Pieter Faure* seems to have been careful. Some, but very few, anomalies in the recorded localities have come to light; and these are most likely to have been due to faulty transcriptions of labels when specimens were sent away to specialists.

In the present instance the P.F. label is not available, but the number P.F. 2561 is entered in the S. Afr. Mus. Register book. The *Pieter Faure* log-book gives for this number the locality as recorded by Sowerby (as above), but does not refer to any Gastropods. Probably therefore the number attached to the shell sent to Sowerby was an error; but any suggestion as to what was the correct number is impossible. The original number might have consisted of *five* numerals, and the label got torn. For example, P.F. 12561 refers to a locality off Cape Natal, 185–200 fathoms, which would be far more credible as the provenance of an example of *tortilis*; but even that number refers to other animals in the haul, not Gastropods.

The recorded locality must, therefore, be accepted provisionally, with the hope that future trawling will obtain further examples of this species in South African waters.

Latiaxis kylix n. sp.

Fig. 37

Shell obconic, flat above, spire very short, whorls rapidly expanding. Protoconch 3 whorls, alt. 0.9, diam. 1 mm., on 1st whorl a very feeble keel below middle of whorl, continued a little more conspicuously on 2nd whorl, with an additional very feeble one above, on 3rd whorl the latter obsolete and the lower keel towards end of whorl overlain by the suture of 1st postnatal whorl, very faint axial pliculae visible chiefly on 2nd whorl, junction with 1st postnatal whorl marked by a curved varix. Postnatal whorls 3, 1st forming with the protoconch the spire, feebly keeled, and with fine axial plicae, the later portion sloping away from spire and passing into the nearly horizontal 2nd whorl; 3rd whorl horizontal above, flat but slightly curved upwards at the periphery where there are 12 angular, complanate processes; growth-lines distinct, shortly squamulose at suture with preceding whorl. Base with obscure spiral striae, visible chiefly near rostrum, which is costate, with 6 squamae.

Fig. 37.
Latiaxis kylix n. sp.

Umbilicus deep. Columella sigmoid. Aperture triangular, canal narrow, curved. Alt. 10, diam. maj. 18, min. 12 mm. Pale buff.

Off Cape Natal (Durban), W. × N. distant 6½ miles, 54 fathoms, one dead (S. Afr. Mus. A8850. P.F. coll.).

Remarks. Shape resembling the Greek kylix, a widely open cup.

Only this one specimen was obtained although the *Pieter Faure* carried out several dredgings in the same area. It is in fresh, unworn condition.

Coralliophila fritschi (von Martens)

Fig. 38(*b*)

1874. Von Martens. *Jahrb. D. Malak. Ges.*, i, p. 135, pl. 6, fig. 3 (*Rapana f.*).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 16 (*Pseudomurex meyendorffi*, non Calcara).
1903. Smith. *Proc. Mal. Soc.*, v, p. 377 (*rubrococcinea*, non M. & S.).
? 1910. id. *Ann. Natal Mus.*, ii, p. 194, pl. 7, fig. 7 (*fragosa*).
1910. Stebbing. *Ann. S. Afr. Mus.*, vi, p. 356 (*Murex* (*Pseudomurex*) *aëdonius*, non Watson).
1914. Tomlin & Shackleford. *J. Conch.*, xiv, pp. 246-7 (*Pseudomurex meyendorffi*, non Calcara).
1923. Tomlin. *J. Conch.*, xvii, p. 46 (*Latiaxis f.*, not the synonymy).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 76, pl. 18, no. 551 (*Tritonalia semidisjuncta*, = subscalariform aberr.).
1932. id. ibid., p. 79 (*C. fritschi* and *Pseudomurex meyendorffi*, non Calcara).
1935. Tomlin. loc. cit., p. 181 (*Latiaxis f.*, not the synonymy).
Not Barnard. *J. Conch.*, xxiv, p. 180, 1957 = *Tritonalia sperata*.

Protoconch 5 whorls, alt. 1·5, diam. 1·3 mm., 1st whorl smooth, glossy, 2nd smooth but minutely crimped at upper suture, and with faint trace of an incipient spiral keel, 3rd–5th whorls bicingulate, crimped at upper suture indicating incipient axial pliculae, 4th and 5th with numerous axial pliculae, slightly protractive from upper suture, strongly protractive between the two keels, then retractive, but scarcely traceable to lower part of whorl where there is a series of minute beads, the lower keel obscured on last part of last whorl by 1st postnatal whorl, keels minutely beaded where the pliculae cross them, junction with 1st postnatal whorl marked by a varix. Postnatal whorls 3, axial ribs 10 on each whorl, prominent on 1st, and becoming flattened, broader, and indistinct on 3rd; crossed by spiral lirae 4 on 1st whorl, the first 2 not prominent, the 3rd strongest and peripheral, 5 at end of whorl due to interpolation of a thin intermediary below the peripheral lira, on 3rd whorl 7 lirae, the 4th peripheral, but at end of whorl 8 lirae, the 5th being peripheral; 5 additional lirae on base of 1st whorl (juv.), 7 in the 3-whorled specimen; all lirae strongly squamate. Rostrum costate and squamate. Columella nearly straight, slightly rimate anteriorly, a feeble umbilicus. Canal short. Aperture piriform, the posterior margin of outer lip horizontal and almost perpendicular to the preceding whorl. One-whorled 5·3 × 3 mm., 2-whorled 7 × 4·3 mm., 3-whorled 11·5 × 7·5 mm., 4-whorled (minus protoconch) 14 × 9 mm.; beach-worn 27 × 16 mm. Von Martens, 'fere 6' whorls 32 × 20 mm. Smith, *fragosa*, 6 whorls 28 × 14 mm.

Operculum oval-reniform, nucleus on outer margin a little below middle.

Creamy-white, operculum amber. Beach shells pink or white.

Only one animal available: no radula was found.

False Bay (von Martens); Port Elizabeth, Port Alfred, East London (auct.). Still Bay and Tongaat (north of Durban) (S. Afr. Mus.). Off Scottburgh (Natal), 168 metres (Stebbing). Scottburgh (Smith: *fragosa*).

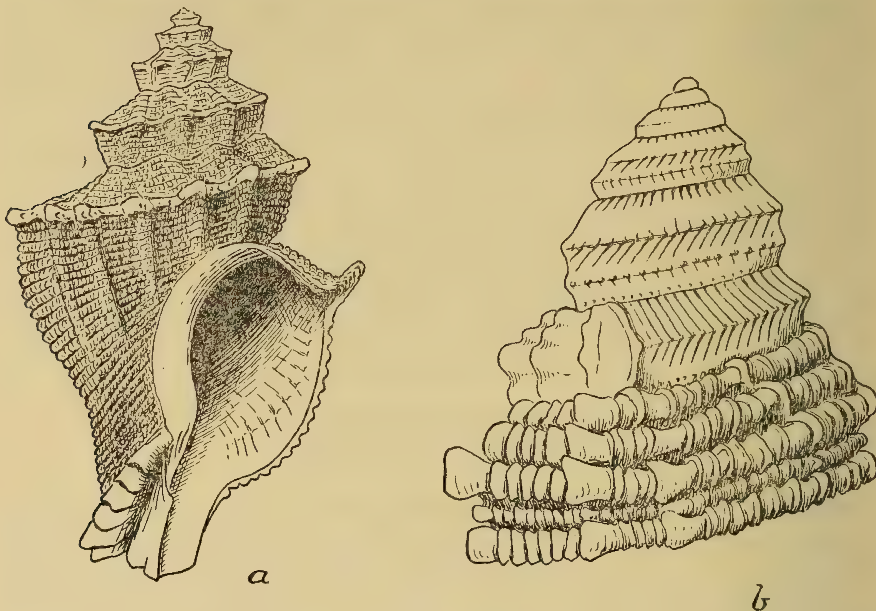


FIG. 38.
(*a*) *Latiaxis tortilis* H. & A. Adams. (*b*) *Coralliophila fritschi* (von Martens).

Off Cape Natal (Durban), 54 fathoms, 1 living, 2 juv.; off Tugela River, 65–80 fathoms, 1 juv.; off Umkomaas, 40 fathoms, 3 and 3 juv.; off Sandy Point (north of Kei River), 51 fathoms, 1 juv.; off Cove Rock (East London), 22 fathoms, 2 juv.; 33° 3′ S. 27° 57′ E., 32 fathoms, 1 juv.; 34° 5′ S. 25° 55′ E., 67 fathoms, 3 juv.; 34° 27′ S. 25° 42′ E., 256 fathoms, 1 juv.; all dead except one (S. Afr. Mus. A8858—A8865. P.F. coll.).

Kosi Bay, and 33° 37′ S. 26° 56′ E., 46 metres (U.C.T.).

Remarks. Von Martens gave a recognizable description and figure of a worn shell (which probably explains why he did not say the lirae were squamose), which can be matched without any ambiguity by numerous beach shells from Still Bay (Muir coll.) and Port Alfred in S. Afr. Mus. It seems strange that the name of a Persian Gulf species (*rubrococcinea*) should ever have been dragged into the South African fauna-list.

There is a tendency to subscalariformity, exemplified by two (out of 30) of the Still Bay shells, which measure (apices worn, only 2nd–5th whorls present) 24 × 12 and 22 × 13 mm. There are 9 axial ribs traceable on the

last whorl in both specimens. Turton's *Tritonalia semidisjuncta* is obviously another example. Von Martens compared the general shape of *fritschi* with *Purpura* (*Rapana, Coralliophila*) *scalariformis* Lam.

The single shell from Tongaat measures 15 × 9 mm. (4 whorls protoconch missing) and has the convex, non-shouldered profile of *fritschi*, though the spire is rather short. It is not a *rosaceus*.

Stebbing referred a Natal Hermit-crab to the Tristan species *Eupagurus tristanensis*, stating that it inhabited the same species of shell: *Murex* (*Pseudomurex*) *aëdonius* Watson. In general appearance there is certainly much similarity between *aëdonius* and *fritschi* (and *fragosa*), but the former has fewer (8) axial ribs. Stebbing did not return the shell with the crab, but I think there is no doubt that it was an example of *fritschi*. (The crab was later referred to an Indo-Pacific species, not the Tristan species.)

I strongly suspect that *fragosa* is only a slender form of *fritschi*, with 9 axial ribs (as in the above subscalariform examples), less convex profile, and posterior margin of the outer lip oblique. Smith said the spiral lirae numbered about 14 on the penultimate and about 36 on the body whorl; the figure shows only 6 and 20 respectively, which agrees very nearly with the number in normal *fritschi*; but possibly the artist did not insert all the fine intermediaries.

The shape of the shell and of the aperture indicate that the above described 3-whorled shell and the juveniles are indubitably *fritschi*. The details of the axial ribs and spiral lirae are the same, though in 5-whorled shells the lirae may increase to 8–9, with 7–8 additional ones on base, and the anterior part of the columella is slightly reflexed over the umbilicus.

Among the beach-worn shells from Still Bay (Muir coll.) is one 4-whorled shell which shows the curved varix at end of the protoconch, preceded by a faint indication of a spiral keel.

The presence of 13 protoconchs in 8 bottom-samples, and one living specimen, in the area between Durban and Algoa Bay, shows that this is by no means a rare species. Beach examples are fairly common within the same area. The species is probably a rock dweller, and this may explain why the *Pieter Faure* obtained only one living example, because she avoided the rough ground and used a fishing-trawl more often than a dredge.

Coralliophila isosceles n. sp.

Fig. 39(*a*)

Protoconch $1\frac{1}{2}$ (2) whorls, alt. 1, diam 1·25 mm., smooth, a faint peripheral keel on last part, junction with 1st postnatal whorl indistinct. Postnatal whorls 4–$4\frac{1}{2}$, profile of spire straight, periphery at bottom of whorls, below which the whorl contracted to the sunken suture. No axial ribs. Spiral lirae on 1st whorl 3, the 3rd peripheral and strongest, on 2nd whorl 5, the 4th peripheral and strongest; on 3rd 5 or 6, the 4th or 5th strongest; on 4th whorl 9, the 6th strongest; 8–9 additional lirae on base; all lirae squamose. Aperture

angularly piriform, contracted anteriorly, rostrum costate, canal open, columella with free edge anteriorly, a shallow umbilicus. 18 (with protoconch) × 12 mm.; 15 (with protoconch) × 10·5 mm. Pale greyish-brown.

Off Glendower Beacon (Port Alfred area), 66 fathoms, 2 dead but fresh (S. Afr. Mus. A4951. P.F. coll.).

Remarks. In general shape somewhat similar to *rosaceus*, but easily distinguished by the straight profile of the spire, the peripheral lira near bottom of whorl, and the absence of axial ribs or knobs.

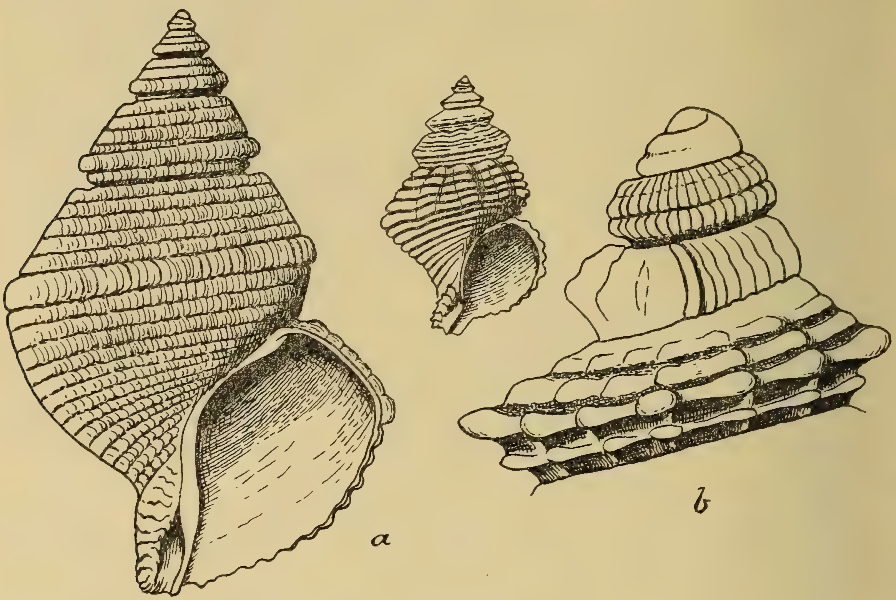


FIG. 39.
(*a*) *Coralliophila isoceles* n. sp. (*b*) *C. zuluensis* n. sp., whole shell to illustrate shape (squamae on lirae not indicated), and protoconch.

Coralliophila zuluensis n. sp.

Fig. 39(*b*)

Protoconch 3½ whorls, alt. 0·6, diam. 0·75 mm., 2nd and 3rd whorls each with *c.* 30 pliculae, cut by 2 spiral striae, the upper one feeble and indistinct, on last half whorl the lower stria and the pliculae below it are concealed by the encroaching suture of the 1st postnatal whorl, the protoconch is consequently lopsided, junction with 1st postnatal whorl marked by a slight varix. Postnatal whorls 6, profile of first 4 carinately angular, of last 2 convex; axial ribs on 1st whorl 10, on 2nd and 3rd 11, on 4th 9, on 5th and 6th 8, broadly rounded, petering out on upper part of base; crossed by spiral lirae 4 on 1st whorl, the 3rd lira most prominent, on 4th and 5th whorls 5, the 4th most prominent, on 5th and 6th 7, the 5th lira a little more prominent than the others, in places 2

additional lirae are visible one above and one below the peripheral lira; on upper whorls the strong peripheral lira forms projecting knobs at the intersections with the axial ribs, on later whorls it merely accentuates the roundness of the ribs; on base 6 additional lirae; all lirae strongly squamulose. Rostrum costate and squamose; canal short, distinctly delimited, partly overgrown by anterior end of columella. 21 × 13 mm.

Uniform cream, interior of canal mauve.

Off O'Neill Peak (Zululand), 90 fathoms, one dead but fresh (S. Afr. Mus. A8852. P.F. coll.).

Coralliobia madreporarum (Sow.)

1832. Sowerby. *Gen. Moll. Purpura*, fig. 2.
1859. Chenu. *Man. Conchyl.*, i, figs. 851, 852.
1880. Von Martens. *Mauritius & Seychellen*, p. 237 (references).
1938. Adam & Leloup. *Mem. Mus. Roy. Hist. Nat. Belg.*, H.S. II, 19, p. 173, pl. 7, fig. 11.

One living example, 15 × 9 mm., white with violaceous columella, rose-madder operculum Delagoa Bay (U.W.).

Distribution. Mauritius, Réunion, East Indies.

Fam. *MURICIDAE*

1929. Thiele. *Handbuch*, i, p. 287.

Murex brevispina Lam.

Figs. 40(*b*), 41(*a*)

1822. Lamarck. *Anim. sans Vert.*, vii, p. 159.
1952. Braga. *Anais Est. zool. Ultramar.*, vii, 3, p. 76, pl. 3, fig. 5.

Protoconch 2½ whorls, alt. and diam. 1·3–1·5 mm., smooth, not sharply demarcated from 1st postnatal whorl.

Radula with *c.* 120 rows, central plate with median cusp longer than side cusps, lateral plate stout (cf. *ternispina*: 1911. Schepman, Siboga Exp. monogr., xlix, pl. 24, fig. 8).

Dead: Durban Bay (Krauss).

Living: Delagoa Bay (K.H.B. coll.; also Braga, and U.W.); Inhambane (U.C.T.).

Murex fallax Smith

Fig. 41(*b*)

1901. Smith. *J. Conch.*, x, p. 113, pl. 1, fig. 9.
1903 (July). Sowerby. *Mar. Invest. S. Afr.*, ii, p. 227.
1903 (Oct.). Smith. *Proc. Mal. Soc.*, v, p. 375.

Protoconch large, 2½ whorls, alt. and diam. 2 mm., smooth. Postnatal whorls 6 (Smith), 1st whorl sharply demarcated from protoconch by a varix;

axial ribs obscure on 1st whorl, *c.* 14 on 2nd, 11 better developed on 3rd; varices not prominent, 3 on each of the later whorls, shoulder bluntly nodular, 3 (sometimes only 2) intervening ribs bluntly nodular at shoulder and at lower end; each varix with only one spine a little above middle of rostrum from 3rd whorl onwards (very feebly developed on 2nd whorl); spiral lirae more prominent on early whorls than the axial ribs, 4 on 1st whorl, on 2nd and 3rd 4 with intermediaries (total 6–7), obscure on later whorls, on base and rostrum of 3rd whorl (juv.) *c.* 24, on 5th whorl of large specimen few and feeble, outer surface of reflexed columella (which forms the inner lip) corrugate; inner columellar surface not lirate. 78 × 41 mm. (Smith); 59 (5 whorls, protoconch missing) × 30 mm.; protoconch plus 2 whorls 13 × 7 mm.; protoconch plus 3 whorls: 18 × 10 mm.

Fig. 40.

Central and lateral radula plates of (*a*) *Murex ramosus* Linn.; (*b*) *M. brevispina* Lam.; (*c*) *Tritonalia puncturata* (Sow.); (*d*) *Trophon acceptans* n. sp.; (*e*) *Drupa squamilirata* (Smith); (*f*) *Thais capensis* (Petit); (*g*) *T. dubia* (Krss.); (*h*) *T. wahlbergi* (Krss.); (*i*) *T. castanea* (Küster); (*j*) *Urosalpinx heptagonalis* (Rve.).

Operculum broadly oval, 14 × 10 mm. in 59 mm. shell, nucleus below centre, growth-lines prominent.

Buff with obscure brown spiral bands, chiefly on the shoulder knobs, and on rostrum, aperture white, operculum amber-brown.

Dead: off Durban, 40 fathoms, from fish stomach (Smith); off Umtwalumi River (Natal), 25 fathoms, 2 juv. (S. Afr. Mus. P.F. coll.).

Living: off Port Shepstone (Natal), 36 fathoms (Sowerby).

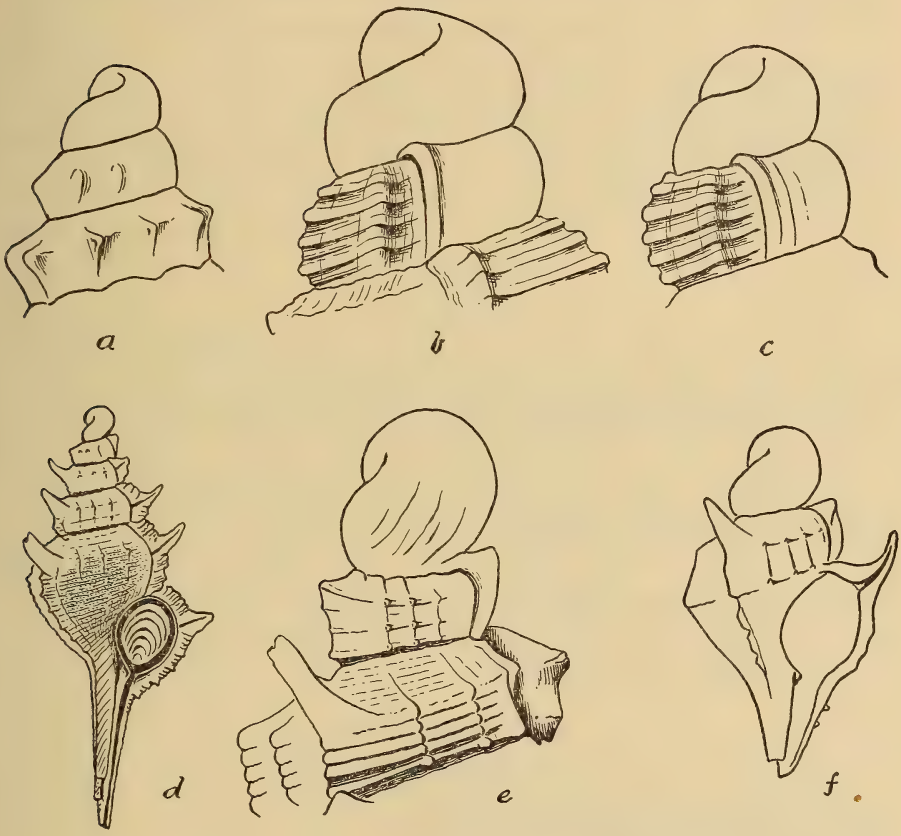


FIG. 41.

(*a*) *Murex brevispina* Lam. (*b*) *M. fallax* Smith. (*c*) *M. axicornis* Lam. (*d*), (*e*) *Murex* sp., whole shell, with protoconch and 1st postnatal whorl further enlarged. (*f*) *Murex* sp. juv.

Remarks. This species has a remarkably large protoconch for a species of this genus, distinctly larger than that of *brevispina*, *axicornis*, and *ramosus*. By this character, and by the sculpture of the apical whorls, juveniles are easily distinguished from *brevispina*.

Unfortunately the animal of the specimen recorded by Sowerby was not preserved.

There are some Ceylonese specimens in S. Afr. Mus. labelled *haustellum*, with pink apertures (? *chrysostoma*). None of them has a protoconch; but the 1st whorl is narrower than that of *fallax*, and presumably the protoconch was also narrower. Axial ribs 14 on 1st and 2nd whorls, 13–14 on 3rd; spiral lirae only 3 on 1st and 2nd whorls, 4 plus intermediaries on 3rd whorl.

Smith said *fallax* differed from *haustellum* in colour, but except the white aperture the large Natal example resembles the Ceylonese specimens.

Murex virgineus Bolten-Röding

1798. Bolten-Röding. *Mus. Bolt.*, p. 141.
1822. Lamarck. *Anim. sans Vert.*, vii, p. 171 (*anguliferus*).
1931. Lamy. *Bull. Mus. Paris* (2), iii, p. 304 (*angulifer* [*sic*]).
1952. Satyamurti. *Bull. Madras Govt. Mus.*, n.s. I, 2, pt. 6, p. 155, pl. 15, figs. 1*a*, 1*b* and var. *ponderosus* Sow.

Ponta Gea, Beira (Lamy).

Murex ramosus Linn.

Fig. 40(*a*)

1758. Linne. *Syst. Nat.*, ed. 10, p. 747, no. 448.
1822. Lamarck. *Anim. sans Vert.*, vii, 160 (*inflatus*, non Brocchi).
1880. Von Martens. *Mauritius & Seychellen*, p. 231 (*inflatus*).
1952. Braga. *Anais Est. zool. Ultramar.*, vii, 3, p. 76 (*inflatus*).

Protoconch 2 whorls, alt. and diam. 1 mm., smooth.

Radula with *c.* 225 rows, central plate with median cusp larger than side cusps, lateral plate rather slender.

Dead: Port St. Johns (very worn) (S. Afr. Mus.); off Itongazi River (between Port Shepstone and Port Edward, Natal), 25 fathoms, one juv. very worn (S. Afr. Mus. P.F. coll.). Delagoa Bay (Braga; and U.W.).

Living: Inhambane (U.C.T.).

Murex axicornis Lam.

Fig. 41(*c*)

1822. Lamarck. *Anim. sans Vert.*, vii, p. 163.
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 227.
1906. Smith. *Ann. Natal Mus.*, i, p. 38.
1911. Schepman. *Siboga Exp. monogr.*, xlix, p. 346, pl. 24, fig. 11 (radula).

Protoconch $2\frac{1}{2}$ whorls, alt. and diam. 1·5 mm., smooth. Postnatal whorls 6, 1st sharply demarcated from protoconch by the spiral lirae but protoconch has also 2–4 fine axial plicae before the junction. Axial ribs 11 on 1st whorl, but indistinct, 10 on 2nd, 9 on 3rd and following whorls, every third rib becoming a varix, the intervening 2 (sometimes in later whorls only one) becoming peripheral knobs, not crossing base in later whorls; each varix with a strong but slender pinnate shoulder spine, followed by 5 (3 on outer lip, 2 on canal) smaller spines, all grooved and hollowed in front; spiral lirae 5 on 1st

whorl, on 2nd and following whorls intermediaries develop so that whole whorl is covered with numerous fine lirae; canal nearly closed. Length 70 mm. (S. Afr. Mus.); 78 mm. (protoconch missing) (U.C.T.).

Operculum broadly oval, nucleus apical, growth-lines prominent.

Buff, with or without brown blotches, or white.

Radula (number of rows ?) central plate with median cusp broader but not longer than side cusps, lateral plate slender (Schepman).

Living and dead: off Cape Natal, 47 and 54 fathoms: off Umhloti River, 40 fathoms; off Umvoti River, 56 fathoms (Sowerby, and S. Afr. Mus. P.F. coll.). 29° 30′ S. 31° 23′ E., 68 metres (s.s. *Africana II*).

Remarks. The depth '110' fathoms in Sowerby was a typ. err.; it was repeated by Smith.

Three specimens in S. Afr. Mus. from the Moluccas vary a little from the South African specimens: two have 2 spines on the canal, the third has 3, and all have only one large spine with 3–4 minor ones on the outer lip.

Murex adustus Lam.

1822. Lamarck. *Anim. sans Vert.*, vii, p. 161.
1859. Chenu. *Man. Conchyl.*, i, fig. 578.
1911. Schepman. *Siboga Exp. monogr.*, xlix, p. 346.
1938. Adam and Leloup. *Mem. Mus. Roy. Hist. Nat. Belg.*, H.S. II, 19, p. 155.
1952. Satyamurti. *Bull. Madras Govt. Mus.*, n.s. I, 2, pt. 6, p. 156, pl. 15, figs. 2 *a*, *b* (not good).

Canal about $1\frac{1}{2}$ times as long as aperture. Varices with pinnate and frondose spines. One prominent rounded knob between each pair of varices. Up to 70 mm.

Ochraceous or fulvous, more or less suffused with smoky-brown or black, especially the frondose varices.

Off Tugela River, 14 fathoms, one worn and discoloured, 37 × 22 mm. (S. Afr. Mus. P.F. coll.).

30° 47′ S. 30° 29′ E., 24 fathoms (U.C.T.).

Remarks. The U.C.T. specimen is covered with a very thin layer of Sponge.

A very similar Indo-Pacific species: *rubiginosus* Rve., which has two knobs or short axial ribs between each pair of varices and is not so 'sun-burnt' in coloration, occurs on the East African coast at Lamu (S. Afr. Mus. coll. E. L. Layard on board H.M.S. *Castor* 1856).

Murex sp.

Fig. 41(*d*), (*e*)

Canal twice as long as aperture, rostrum elongate. Protoconch large, lopsided, 2 whorls, alt. 2·5, diam. 2 mm., smooth, ending with a plain narrow varix. Postnatal whorls 4; axial ribs 12 on each whorl, every 4th rib forming

a sharp varix, with a simple slightly curved hollow spine at shoulder; spiral lirae 3 on 1st whorl, uppermost one forming the shoulder, following whorls with lirae above shoulder and intermediaries below, on last whorl respectively 8 and 10–12, the shoulder lira forming complanate nodules at intersections with the ribs between each pair of varices; about 8 additional lirae on base and rostrum, with intermediaries; edge of varices below shoulder spine serrate-crenulate. Growth-lines between the varices forming a cancellate-granulate sculpture. Aperture rimate. Canal nearly closed. 37 × 14 mm.

Operculum broadly oval, 6·5 × 4·75 mm., nucleus near apex, growth-lines prominent.

Radula with *c.* 130 rows, central plate with median cusp longer than side cusps, lateral plate slender.

Off Cape Natal, 85 fathoms, one living (S. Afr. Mus. A8833. P.F. coll.).

Murex sp. juv.

Fig. 41(*f*)

Protoconch 2 whorls, alt. 1·5, diam. 1·25 mm., smooth, ending in a plain narrow varix. First postnatal whorl with 3 varices, each with a simple, curved, hollow shoulder spine, and 3 nodules between each pair. Total length 5 mm.

Off Cape Natal, 85 fathoms, one juv. (S. Afr. Mus. A8834. P.F. coll.).

Although taken in the same haul as the previous species, this juvenile belongs to a different species because the protoconch is much smaller. Larger specimens might show some resemblance to the East Indies *falcatiformis* Thiele (1925. *D. Tiefsee Exp.*, xvii, p. 168, pl. 30 (18), fig. 10).

'Murex' *uncinarius* Lam.

Fig. 42(*a*)

1822. Lamarck. *Anim. sans Vert.*, vii, p. 166.
1840. Sowerby. *Proc. Zool. Soc. Lond.*, p. 143, and *Conch. Illustr.*, no. 53, fig. 76 (*Murex capensis*).
1848. Krauss. *Südafrik. Moll.*, p. 112 (*capensis ? uncinarius*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 24 (*Murex* (*Pteronotus*) [*sic*] *u.*).
1925. Thiele. ibid., xvii, p. 168 (*Murex* (*Pterymurex*) *u.*).
1929. id. *Handbuch*, i, p. 299 (*Tritonalia* (*Poropteron*) *u.*).

Protoconch 1½–2 whorls, alt. and diam. 0·8–0·9 mm., smooth. Postnatal whorls 6, 1st sharply demarcated from protoconch; 1st whorl with 10 axial ribs, 2nd with 8, but towards end of 2nd the alternate ribs begin to become carinate varices with hollow, alate-uncinate expansions, 3rd and later whorls each with 3 varices alternating with 3 low rounded peripheral convexities (scarcely bosses), profile evenly convex to the convexity (no angular shoulder); on last 3 varices the uppermost (largest) alate expansion more or less uncinately curved upwards towards apex, exsert (not incurved); 2–4 (ocasionally 5) smaller acute processes below the large uppermost expansion; on preceding

whorl these processes (except one at suture) are concealed by the succeeding whorl; spiral lirae on 1st whorl 2 peripheral, obsolete on 2nd whorl, replaced on this and following whorls by numerous fine striae, particularly well marked on hinder side of the varical expansions; on 5th and 6th whorls the peristome appears to become continuous and the canal closed at the formation of each successive varix. 27 (6 whorls, protoconch missing) × 12 (excl. processes) 19 mm. (incl. processes); smallest specimen seen (protoconch plus 3 whorls) 17·5 × 2·5 mm. (excl. processes).

Operculum and animal unknown.

Pure white, porcellanous. Beach specimens tend to become buff, pinkish, or brown.

Port Elizabeth, Port Alfred, Still Bay, False Bay (auct. and S. Afr. Mus.). St. Francis Bay, 80–100 metres (von Martens); 35° 29′ S. 22° 26′ E., 155 metres (Thiele). Algoa Bay, 25 fathoms; off Cape Morgan, 87 fathoms, off Cape Natal, 54 fathoms (S. Afr. Mus. P.F. coll.).

34° 15′ S. 25° 5′ E., 6 fathoms (U.C.T.).

Remarks. The *Pieter Faure* took four specimens (including the largest 27 mm.) in Algoa Bay, two of them in fresh condition with protoconchs; two from off Cape Morgan are also fresh with protoconchs and well-marked spiral striae; the Natal specimen is complete but encrusted with Serpulids.

The locality Table Bay (S. Afr. Mus.) is not acceptable.

So far as I am aware the radulae of this species and the following *mitraeformis* are unknown. The correct genus therefore remains uncertain: Thiele in

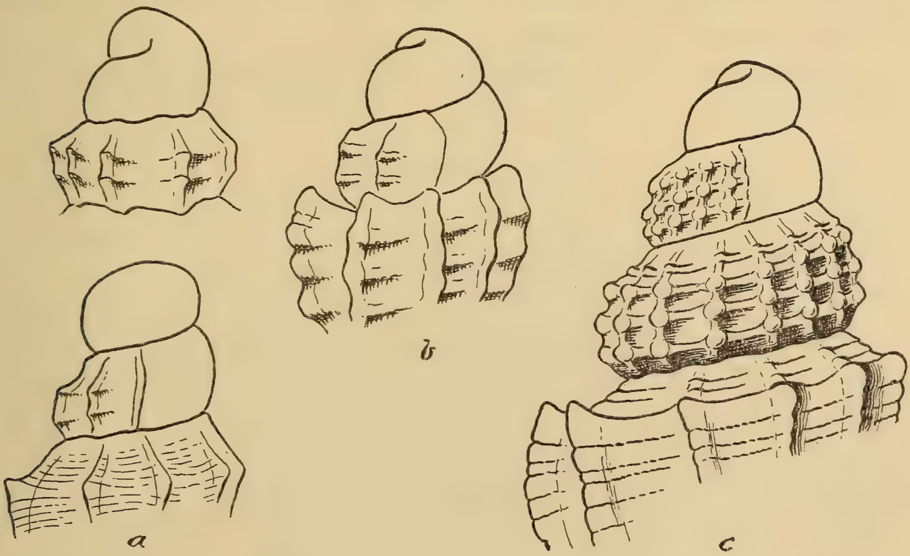


FIG. 42.
(*a*) 'Murex' *uncinarius* Lam., two views of protoconch. (*b*) 'M.' *mitraeformis* Sow. (*c*) 'M.' *wahlbergi* Krss.

1925 put *uncinarius* in *Murex* section *Pterymurex* (Rov. 1899, a synonym of *Pterynotus* Swainson 1840), but in 1929 in *Poropteron* Jouss. 1880, a section of *Tritonalia.*

'Murex' *mitraeformis* Sow.

Fig. 42(*b*)

1841. Sowerby. *Proc. Zool. Soc. Lond.* and *Conch. Illustr.*, fig. 75 (quoted from Krauss).*
1848. Krauss. *Südafrik. Moll.*, p. 112.
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 3 (quotes *Conch. Illustr.*, fig. 75).

In general similar to *uncinarius* but more turreted owing to the whorls being tabulately shouldered (with an obscure ridge) and sutures deeper.

Protoconch 1½ whorls, alt. and diam. 0·75 mm., smooth. Postnatal whorls 5, 1st sharply demarcated from protoconch; 1st whorl with 9 axial ribs, 2nd with 7, 3rd–5th each with 3 varices alternating with 3 bosses. The uppermost and largest expansion on each varix is more tabulate than alate, and strongly uncinately curved towards apex, the tips incurved and often touching the preceding whorl; below the large uppermost expansion on last 3 whorls are 6 smaller processes, blunt, hook-like and curved forwards, at least 2 of which (sometimes 3) are exposed; spiral lirae 2 on 1st whorl, 3 on 2nd, becoming 4 on 3rd, and thereafter replaced by numerous spiral striae. Canal closed. 22 (protoconch missing) × 9 mm.

Operculum and animal unknown.

Cape and Natal (Sowerby, Krauss); Still Bay, Port St. Johns, and Tongaat (Natal) (S. Afr. Mus.). The west coast of the Cape Peninsula (S. Afr. Mus.) is scarcely acceptable as a locality.

Remarks. One of six beach specimens from Still Bay retains the protoconch and spiral striae.

'Murex' *wahlbergi* Krss.

Fig. 42(*c*)

1848. Krauss. *Südafrik. Moll.*, p. 111, pl. 6, fig. 13.
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 3 (*Trophon w.*).

Protoconch 2 whorls, alt. and diam. 1·3 mm., smooth. Postnatal whorls 6, profile from 2nd or 3rd whorl onwards angularly shouldered, 1st whorl sharply demarcated from protoconch. Axial ribs on 1st whorl 14, on 2nd 13–12, on 3rd 10–9, on 4th, 5th and 6th 9–8, 6th whorl sometimes with only 7 ribs, from suture to suture, and extending across base to rostrum; from the shoulder downwards on 3rd and following whorls the ribs are lamellate, somewhat variable but when well developed sharply pointed at shoulder, and hollowed

* Krauss's reference to Sowerby seems to be incorrect, though Sowerby himself quoted fig. 75. Sherborn does not list 'mitraeformis Sow.' except as a *Scalaria* 1844, only *mitraeformis* Brocchi 1814 and *mitriformis* Wood 1828, nom. nud. Sowerby, *Proc. Zool. Soc.*, 1840, p. 143, gives 'fig. 75' for his *cancellatus*.

in front; spiral lirae on 1st and 2nd whorls 3, almost as strong as the ribs, with a feeble one between suture and shoulder on 2nd whorl, on 3rd 4 lirae with 2–3 feeble ones above shoulder, on 4th 4–5 or 6 lirae with 4–5 feeble ones above shoulder; lirae becoming broad and flat with narrow intervals, so that on later whorls the sculpture is more correctly described as striate. Sculpture thus cancellate on first 2 whorls (with transversely oblong hollows), axially ribbed on later whorls and lirate/striate in the intervals. Rostrum rimate. Canal when fully developed nearly closed. Outer lip plicate within. 41 × 22 mm.

Operculum and animal unknown.

Rubescent, aperture pale reddish or violaceous (Krauss). Natal (Krauss).

Remarks. Intermediary striae are developed on the body whorl, producing a somewhat similar sculpture to that of 'Purpura' *wahlbergi*, but the striae are never so numerous and close together, nor crispate, as in the latter species; young worn shells might, however, be difficult to identify.

Four adult shells in S. Afr. Mus. were presented by C. A. Fairbridge (who lived in Cape Town) in 1887, and were registered as coming from Table Bay. This locality is very doubtful as no specimens have since been recorded from any Cape locality.

There are also in S. Afr. Mus. 5 juveniles, 6·5–19 mm. long, without locality but probably collected in Natal (ex coll. Juritz).

Until the animal is discovered Sowerby's suggestion to transfer this species to *Trophon* is only provisional.

Trophon carduus (Brod.)

1832. Broderip. *Proc. Zool. Soc. Lond.*, p. 175 (*Murex c.*).
1903. Sowerby. *Mar. Invest. S. Afr.*, ii, p. 227 (*Trophon c.*).
1906. Smith. *Ann. Natal Mus.*, i, p. 38 (*Coralliophila c.*).

Protoconch $1\frac{1}{2}$ whorls, alt. 0·5, diam. 0·75 mm. (but slightly worn), smooth. Postnatal whorls 6. Axial ribs 11 on all whorls, with angular shoulder, continued across base on body whorl; spiral lirae one on 1st whorl (at shoulder), 2 on 2nd (upper one forming the shoulder), 3 on 3rd and following whorls, intersection of shoulder lira with ribs on 1st and 2nd whorls forming little points, on 3rd and following whorls forming short blunt spines, grooved and hollowed in front, 3rd lira with shorter spines, 2nd lira with vaulted scales; on 5th and 6th whorls an intermediate lira between 2nd and 3rd lirae, with vaulted scales; 6 main lirae, with intermediaries, on base, all scabrous; on 5th whorl between suture and shoulder 4, and on 6th whorl 5 spiral series of vaulted scales marking the lines of growth. Columella reflexed, canal open, probably subequal in length to aperture (tip broken). 23·5 (canal tip broken) × 13 mm.

Operculum broadly oval, nucleus apical, 6 × 4 mm.

White, operculum amber-brown.

Living: off Port Shepstone (Natal), 250 fathoms (Sowerby).

Remarks. The above description is from the specimen recorded by Sowerby (now in S. Afr. Mus.); it does not correspond with Broderip's brief description, which said 'sexfariam varicosa-spinosa', and made no mention of the vaulted scales. On the Natal specimen the spinose varices are undecimfariam and the shoulder spines increase evenly in length around the whorls, and cannot be divided into groups of 6 (sexfariam).

Smith suggested the *species* (? whether he saw the Natal specimen) could be included in *Coralliophila*, but Sowerby's placing in *Trophon* seems better. The animal of the Natal specimen was not preserved.

Sowerby said the species was 'very rarely met with', but gave no other locality than Broderip's original one from Peru.

The Australian *T. carduelis* Watson is a very different shell.

Trophon acceptans n. sp.

Figs. 40(*d*), 43(*b*)

Protoconch $1\frac{1}{2}$ whorls, alt. 1, diam. 0·75–0·9 mm., smooth. Postnatal whorls 6, profile of first 3 whorls evenly convex, of later whorls angularly shouldered slightly above the middle; axial ribs on 1st whorl 10, on 2nd 10–11, on 3rd 11–12, on 4th and 5th 12–13, on 6th 13–14, arching over the suture at top, extending across base to rostrum, broad basally but sharply keeled on body-whorl in juveniles and one adult, but abraded in the others, the intervals in cross-section V-shaped (not U-shaped), the back slope steeper than the forward slope; no spiral sculpture but a very slight indication of a shoulder keel between the ribs on body-whorl of adults, and two below even more obscure. Canal subequal to aperture, open. Protoconch plus 2 whorls $5 \times 2{\cdot}25$ mm., protoconch plus 3 whorls $6{\cdot}5 \times 2{\cdot}5$ mm., adult $21 \times 9{\cdot}5$ mm. (figured specimen 18×8 mm.).

Operculum oval, nucleus apical.

Pure white, juveniles pale buff, operculum amber.

Radula with *c.* 100 rows, central plate with median cusp a little longer than side cusps, a minute denticle between median and side cusp, lateral plate blade subequal in length to base.

Cape Point E. $\frac{3}{4}$ N., distant 36 miles, 630 fathoms, 5 adults; Cape Point N. 64° E. 37 miles, 700–800 fathoms, one adult; Cape Point E. × N., 35 miles, 500 fathoms, one adult living; Cape St. Blaize N. × E., 73 miles, 125 fathoms, 4 juv. (one living); 34° 26′ S. 25° 42′ E., 124 fathoms, 4 juv.; off Cove Rock (East London area), 80–100 fathoms, one juv., S. Afr. Mus. A3449, A3473 (Type), A3480, A8633, A8634, A8840. P.F. coll.).

Remarks. Of the five remaining adults (two were sent to Tomlin) all are more or less abraded; four are matt chalky white, the fifth (figured, A3473) very little abraded on the body-whorl which is almost glossy, especially within the aperture. The juveniles are clean and fresh.

One juvenile (off Cape St. Blaize) 8 mm., has 10 axial ribs on 1st–3rd whorls, but only 9 more widely spaced on the 4th whorl. Its radula corresponds with that of the type.

In describing *declinans* (1886. *Challenger Rep.*, xv, p. 168, pl. 10, fig. 10) from 69 fathoms off Marion Island, Watson was inclined to regard it as conspecific with the North Atlantic *truncatus* Strom. (see: Sars, 1878. *Moll. Arct. Norveg.*, p. 246, pl. 15, fig. 9) and separated it only in deference to the opinion of Sars and Gwyn-Jeffreys. There is a slight but distinct difference in the convexity of the profile from apex to aperture between the figures of the two species.

The present specimens (adults) have stronger shoulders than either *truncatus* or *declinans*, more like *clavatus* Sars (loc. cit., pl. 15, fig. 12), but the last species has the ribs acute at the shoulders; nor are the shoulders so high up as in *clathratus* Linn. (Sars, loc. cit., pl. 15, fig. 10). The axial ribs are fewer than in *truncatus* and *declinans*.

The *Pieter Faure* specimens thus seem worthy of acceptance as a species distinct from *declinans*. Possibly connecting forms may exist in the area between South Africa and Marion Island.

There is a strong resemblance to *tenuirostratus* Smith (1899. *Ann. Mag. Nat. Hist.* (7), iv, p. 241, and 1901. *Illustr. Zool. Investigator. Moll.*, pl. 10, figs. 4, 4a) from the Andaman Islands, 185 fathoms. The body-whorl has 3 scarcely visible spiral keels as in the Cape specimens, but there are one or two fewer axial ribs, and the upper whorls are shouldered slightly *below* the middle.

Trophon ? *incertus* n. sp.

Fig. 43(*a*)

Protoconch 2 whorls, corroded. Postnatal whorls 5, profile strongly shouldered about in middle of whorl, sutures undulate; axial ribs 12 on 1st whorl, 12–13 on 2nd, 13–14 on 3rd, 14–15 on 4th, 16–17 on 5th, from suture to suture, slightly curved above shoulder, extending across base; crossed by a spiral lira at shoulder, and one (Type) or 2 (cotype) below shoulder, about 12 additional lirae on base, with an intermediary between each pair; intersections slightly tubercular, strongest at shoulder. Columella nearly straight. 13–14 × 6 mm. Pale buff.

Off Cape Natal (Durban), 440 fathoms, two (S. Afr. Mus. A8843. P.F. coll.).

Remarks. Similar to *Trophon* ? *celebensis* Schepman (1913. *Siboga Exp. monogr.*, xlix, p. 452, pl. 30, fig. 13) except that the latter has 5 spiral lirae on body-whorl, and 20 axial ribs. The *Siboga* shell was obtained at 462 metres in the East Indies.

Schepman remarked that it might possibly prove to be a Pleurotomid. In the present two shells the ribs above the shoulder and the intervening growth-lines are slightly concave, but scarcely as strong as in most Pleurotomids (*Surcula*); there is no minute crinkling at the suture.

Trophon sp. juv.

Fig. 43(*c*)

Protoconch $1\frac{1}{2}$ whorls, low, alt. 0·5, diam. 0·8 mm., smooth, a few very fine pliculae or growth-lines before the definite axial ribs begin. Postnatal whorls 3, shouldered, profile above and below shoulder straight; axial ribs 14 on 1st whorl, 17 on 2nd, 20 (21) on 3rd, at shoulder slightly nodular and connected by a lira, feeble on 2nd, indistinct on 3rd whorl, extending not quite to suture above and obsolete on base. Columella curved, canal rather long. 5·25 × 2·5 mm. Cream.

Off Cape Natal (Durban), 440 fathoms, one juv. (S. Afr. Mus. A8841. P.F. coll.).

Remarks. The shell is extremely fragile. Although there is no trace of a lip sinus, this shell might possibly be a *Surcula.*

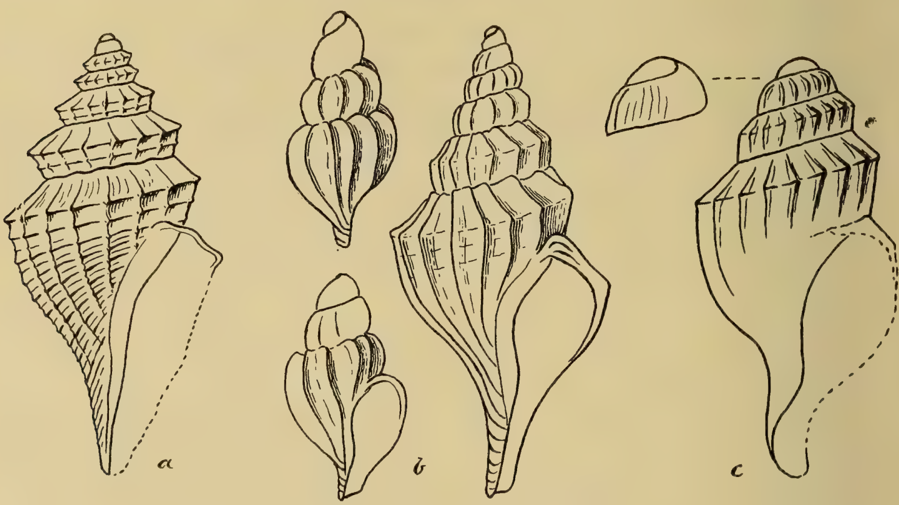


FIG. 43.
(*a*) *Trophon incertus* n. sp. (*b*) *T. acceptans* n. sp., with two views of juvenile. (*c*) *Trophon* sp. juv.

Trophon acutispira (Sow.)

Fig. 44(*c*), (*d*)

1921. Sowerby. *Proc. Mal. Soc.*, xiv, p. 125, text-fig. (*Cominella a.*).
1931. Tomlin. *Ann. Natal Mus.*, vi, p. 429 (*Cominella a.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 52 (*Cominella a.*).
1947. Tomlin. *J. Conch.*, xxii, p. 271 (*Afritrophon a.*).

Protoconch 2 whorls, smooth. Postnatal whorls 3. The 11–12 axial ribs are equally as strong as the two spiral lirae, with nodules at the intersections; 4–5 additional lirae on base. 5 mm. long.

Operculum oval, nucleus on outer margin below middle.

Radula with *c.* 115 rows, central plate with 3 subequal cusps, postero-lateral corners of base acute, lateral plate slender.

Port Alfred (Sowerby, Turton).

Living: Lambert's Bay (U.C.T.).

Remarks. The above description from a single specimen (U.C.T.). If it is correctly identified, *acutispira* with its smooth protoconch cannot be included in the genus *Afritrophon* (*v. infra*).

Sowerby described two specimens, 10 × 4 mm., with 2 smooth apical whorls followed by 4 bilirate whorls, base with 4 additional lirae, and axial ribs forming a 'crisply nodulous' cancellate sculpture. Above the shoulder the whorls are 'concavely depressed', a character which apparently induced Sowerby to place the species in *Cominella*.

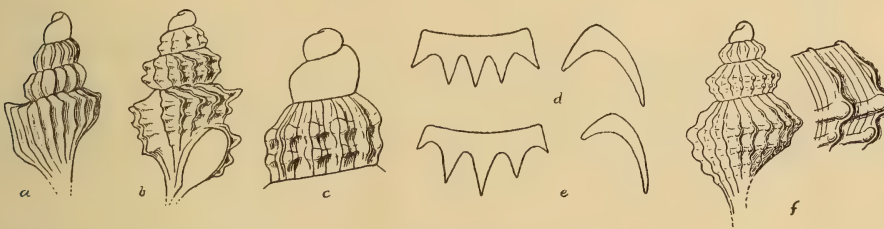


FIG. 44.

(*a*) *Trophon mioplectos* n. sp. (*b*) *T. johannthielei* n. sp. (*c*) *T. acutispira* (Sow.). (*f*) *T. pistillum* n. sp. Central and lateral radula plates of (*d*) *T. acutispira* (Sow.); (*e*) *Afritrophon kowieensis* (Sow.).

Trophon jucundus Thiele

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 169, pl. 30 (18), fig. 13.
1947. Tomlin. *J. Conch.*, xxii, p. 271 (*Afritrophon j.*).

Protoconch $1\frac{1}{2}$ whorls, alt. 0·75, diam. 0·5 mm., smooth. Postnatal whorls $3\frac{1}{2}$, rather squarely shouldered immediately below the sutures; 1st whorl sharply demarcated from protoconch, with 11 axial plicae, 2nd whorl with 14, 3rd with 18 (counting from outer lip upwards the body-whorl has 21); plicae thin, with free edges, from suture to suture, extending across base to canal; on 2nd and 3rd whorls 3 spiral lirae, on last half-whorl 4 (by interpolation between 1st and 2nd series); lirae not so prominent as the axial plicae which form vaulted squamulae at the intersections; 2 additional lirae on upper part of base, but none on lower part, the plicae on base not or only feebly crinkled. Outer lip patulate. 5 × 2·3 mm. (Thiele); 5 × 2·5 mm. (S. Afr. Mus.). Pale buff.

35° 16′ S. 22° 26′ E., 155 metres, one (Thiele).

Off Cape St. Blaize (N. × E., 73 miles), 125 fathoms, one (S. Afr. Mus. A8619. P.F. coll.).

Remarks. The *Pieter Faure* specimen came from almost the same locality as the *Valdivia* specimen. The tip of the canal is broken, but otherwise the shell is unworn. The thin, strongly crispate and outstanding plicae overshadow the

spiral lirae, and thus the sculpture appears a little less distinctively cancellate than in Thiele's figure.

The smooth protoconch precludes the inclusion of this species in *Afritrophon*.

Trophon mioplectos n. sp.

Fig. 44(*a*)

Protoconch $1\frac{1}{2}$ whorls, alt. 0·75, diam. 0·5 mm., smooth, junction with 1st postnatal whorl clearly marked. Postnatal whorls 3; axial plicae on 1st whorl 13, on 2nd 14, on 3rd 15, lamellate, sharp, from suture to suture and extending across base to rostrum; profile of 2nd whorl obscurely biangulate, of 3rd more distinctly biangulate. Tip of canal broken. No spiral sculpture. 4 × 2 mm. Dirty white.

34° 27′ S. 25° 42′ E., 256 fathoms, one (S. Afr. Mus. A8631. P.F. coll.).

Remarks. Differs from *denseplicatus* Turton 1932 and *gemmulatus* Turton 1932 (the latter appears to be synonymous with the former) in having fewer axial plicae, presuming Turton's count was correct. He gave 'nearly 30' for *denseplicatus* and 'nearly 20' for *gemmulatus*. Both photographs are rather poor, but even that of *denseplicatus* seems to indicate at most 20 plicae.

Trophon johannthielei n. sp.

Fig. 44(*b*)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 170, pl. 30 (18), fig. 16 (*Trophon* sp. juv.).

Protoconch $1\frac{1}{2}$ whorls, alt. 0·5, diam. 0·75 mm., smooth. Postnatal whorls 3, profile biangulate, junction with protoconch abrupt. Axial plicae 11 on each whorl, strongly retractive from suture to shoulder and then vertical, thin, with free edges, and squamosely raised at intersections with 2 feeble spiral lirae. Plicae extend from suture to suture, and across base, with squamulae on 2 additional lirae. Growth-lines obscure. Tip of rostrum broken. 5 × 2·8 mm. Pale buff.

35° 19′ S. 20° 12′ E., 126 metres, one (Thiele).

Off East London, 400–450 fathoms, one, exceedingly fragile (S. Afr. Mus. A8844. P.F. coll.).

Remarks. Thiele's example with protoconch plus 2 whorls measured 3·6 (according to the magnification of his figure). The thin free-edged plicae are similar in this species and *jucundus* Th., but are more numerous and less strongly squamate in the latter. Also the shape of the protoconch is different.

Trophon pistillum n. sp.

Fig. 44(*f*)

Protoconch $1\frac{1}{2}$ whorls, alt. 0·8, diam. 0·75 mm., smooth. Postnatal whorls 3, profile angular, Axial plicae 11–12 on 1st whorl, 13–14 on 2nd,

15–16 on 3rd, retractive (but less so than in *johannthielei*) from suture to shoulder, then vertical, thin, with free edges, squamately raised at intersections with 2 feeble spiral lirae; plicae extending from suture to suture, and across base with tubercles on 2 additional lirae. The squamae on the plicae are not hollow in front, but filled in with a tiny plug or tubercle, rather like the piston in a cylinder (with incomplete rim). 3 or 4 growth-lines distinct between each pair of plicae. Rostrum broken. Approximately 5 × 3 mm.

Operculum oval, nucleus apical.

Radula with *c.* 70 rows, central plate with 3 cusps, the median one larger than the side cusps, postero-lateral corner of base acute.

Off Cape Natal (Durban), 440 fathoms, one, exceedingly fragile (S. Afr. Mus. A8842. P.F. coll.).

Gen. AFRITROPHON Tomlin

1947. Tomlin. *J. Conch.*, xxii, p. 271.

Protoconch bicingulate. Postnatal whorls with one or more strong spiral lirae; axial ribs present on 1st postnatal whorl; on following whorls either well developed or obsolete. Sutures deep. Canal short. Operculum ovoid, nucleus on outer margin near apex.

Radula, central plate with 3 rather large cusps, postero-lateral corners of base acute, lateral plate slender.

Genotype: *Trophon kowieensis* Sow. 1901.

Remarks. Tomlin saw no specimen with an unworn protoconch, and did not mention it in his generic diagnosis. Fortunately for his genus, however, he happened to choose as genotype one of the species which has a peculiar protoconch.

Of the other four species included by Tomlin in his genus, *insignis* Sow. and *agulhasensis* Th. have similar protoconchs, and are rightly included. But *jucundus* Th. and *acutispira* Sow. (if my identification of the latter is correct) have a perfectly smooth protoconch and must be excluded. I refer them back to *Trophon.*

Tomlin declined to comment on Turton's (1932) four 'species'. One might, however, suggest that the figures of *denseplicatus* and *gemmulatus* indicate merely different aspects of the same species; *subglobosus* seems to be a *Turritella*; and *ornatus* is definitely the protoconch of a Turritid (cf. 'Clathurella' *capensis*).

An example of Thiele's 'Trophon sp. juv.' has been found in the *Pieter Faure* material; as it has a smooth protoconch it also is retained in *Trophon* (see *johannthielei*, p. 206).

Afritrophon kowieensis (Sow.)

Figs. 44(*e*), 45(*a*)

1901. Sowerby. *Proc. Mal. Soc.*, iv, p. 213, pl. 22, fig. 16 (*Trophon k.*).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 169 (*Trophon ? kowiensis* typ. err.).
1947. Tomlin. loc. cit., p. 271.

Protoconch $1\frac{1}{2}$ whorls, bicingulate. Postnatal whorls 4 ($4\frac{1}{2}$); axial ribs on 1st whorl 14–15, at first interrupted by the 2 spiral lirae, but later forming nodules at the intersections, on 2nd whorl 18–20, on 3rd 26–28, on 4th *c.* 28–34, from suture to suture, obsolete on base; on the 2nd whorl the nodules gradually become vaulted squamae, hollow in front; on the last whorl they are closely aggregated but vary in number; on 3rd and last whorls the axial ribs between suture and upper peripheral lira also become vaulted squamae. On base 4–5 additional squamose lirae. 8 × 3·3 mm.

Operculum ovoid, nucleus on outer margin near apex.

Radula with *c.* 130 rows, as in generic diagnosis.

Kowie (= Port Alfred) (Sowerby, Bartsch, Turton).

Agulhas Bank 80 metres, St. Francis Bay, 80 metres, and Algoa Bay, 102 metres (Thiele).

Off Great Fish Point, 22 fathoms; Algoa Bay; off Cape Recife, 52 and 124 fathoms; off Knysna Heads, 46 fathoms; off Cape St. Blaize, 125 fathoms; 34° 27′ S. 25° 42′ E., 256 fathoms (S. Afr. Mus. P.F. coll.).

Living: Algoa Bay, 60 fathoms; False Bay, 30 metres (U.C.T.).

Remarks. The original spelling was, quite correctly, *kowie - ensis*, and should be retained.

At first sight somewhat resembling a very slender *T. scrobiculata* (p. 212).

Recorded also by Thiele from Great Fish Bay, Angola, but the identity of this specimen, should, with due respect to Thiele, be accepted with reserve.

Afritrophon agulhasensis (Thiele)

Fig. 45(*c*)

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 169, pl. 30 (18), fig. 12 (*Trophon ? a.*).
1947. Tomlin. loc. cit., p. 271.

Protoconch $1\frac{1}{2}$ whorls, bicingulate. Postnatal whorls 5 (Thiele gave *total* number of whorls in his specimen 6); axial ribs on 1st whorl 15, at first interrupted by the 2 spiral lirae, later forming nodules at the intersections; on 2nd whorl 14–13, later whorls 13–12, nodules at intersections becoming stronger and more outstanding, especially on the upper peripheral lira on 3rd–5th whorls, some of them auriculate, hollowed in front; ribs extending from suture to suture, obsolete on base; on base 4 less strongly nodose-squamose lirae and an indistinct 5th on rostrum. 8 × 3·5 mm.

Operculum ovoid, nucleus on outer margin near apex.

Radula with *c.* 145 rows, as in generic diagnosis.

35° 16′ S. 22° 26′ E., 155 metres (Thiele).

Off Cape St. Blaize, 125 fathoms; 35° 5′ S. 25° 55′ E., 67 fathoms; 34° 27′ S. 25° 42′ E., 256 fathoms (S. Afr. Mus. P.F. coll.).

Beach specimens: False Bay and Still Bay (S. Afr. Mus.).

Living: False Bay (U.C.T.).

Remarks. Although similar to *kowieensis*, this species, as Thiele said, is quite distinct: the area between suture and upper peripheral lira is quite smooth except for the fine non-squamose axial plicae, and the axial plicae are fewer; the nodules in unworn specimens are more outstanding and strongly auriculate.

In Thiele's specimen the 3rd (as here reckoned, = Thiele's 5th) lira on the base was not developed.

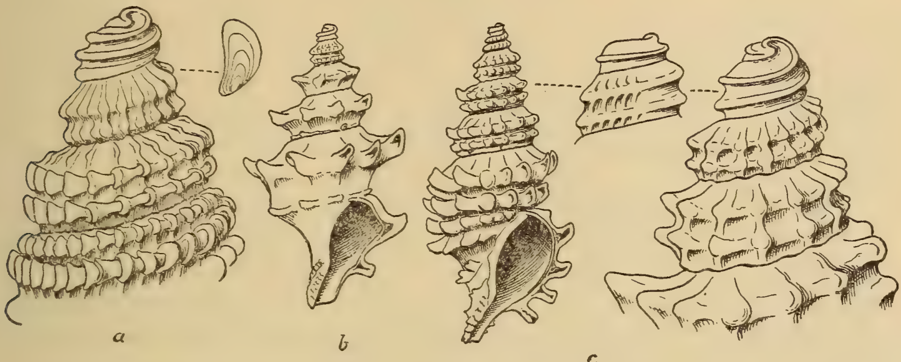


FIG. 45.

(*a*) *Afritrophon kowieensis* (Sow.), apex and operculum. (*b*) *A. insignis* (Sow.). (*c*) *A. agulhasensis* (Thiele), with apex and protoconch further enlarged.

Afritrophon insignis (Sow.)

Fig. 45(*b*)

1900. Sowerby. *Proc. Mal. Soc.*, iv, p. 2, pl. 1, fig. 1 (*Trophon* ? *i.*).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 170, pl. 30 (18), fig. 14 (*Trophon i.*).
1947. Tomlin. loc. cit., p. 271.

Protoconch 1½ whorls, bicingulate. Postnatal whorls 4; 1st whorl with axial ribs and 2 spiral lirae as in the two previous species; from end of 1st whorl the lower lira is for the most part occluded by the suture of the following whorl, though here and there a tiny auriculate tubercle projects; the upper lira becomes very prominent with 8 or 9 sharp, auriculate, upturned tubercles; on base the 2nd lira becomes visible again, with auriculate tubercles less prominent than those on the upper lira; no other lirae on base; fine growth-lines distinct. 6·5 × 3 mm.

Kowie (= Port Alfred) (Sowerby, Bartsch, Turton, S. Afr. Mus.).

Off Cove Rock (East London area), 22 fathoms, 3 dead but fresh (S. Afr. Mus. A8849. P. F. coll.).

Remarks. In worn specimens the projecting tubercles become merely undulations on the peripheral keel; these undulations were not mentioned in the original description, but can be seen in the cotypes in S. Afr. Mus.

Thiele recorded a 3·7 mm. juvenile from Great Fish Bay, Angola; but I feel that the identification needs confirmation.

Gen. Typhis Montfort

1929. Thiele. *Handbuch*, i, p. 293, fig. 318 (radula).

Radula with wide central plate, 1–3 small cusps between the median and side cusps, lateral plate unicuspid, uncinate.

Typhis arcuatus Hinds

Fig. 46(*a*)–(*g*)

1843. Hinds. *Proc. Zool. Soc., Lond.*, p. 19.
1844. id. *Moll. Voy. Sulphur*, p. 10, pl. 4, figs. 1, 2.
? 1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 94, pl. 3, fig. 2 (*transcurrens*).
1925. Thiele. ibid., xvii, p. 170.

Protoconch $1\frac{1}{2}$ whorls, alt. 1·3, diam. 1 mm., smooth, glistening. Postnatal whorls 5; 4 tubes and 4 varices on each whorl; tubes subcircular on early whorls, becoming oval and carinate in front on later whorls, sometimes on last whorl narrowly oval (complanate); varices curving forwards, carinate, connected with the tubes, but with a shallow notch at base of tube defined by a feeble angulation. 20 × 10–11 mm. (excl. tubes).

Operculum broadly oval, fitting the continuous peristome, nucleus apical, growth-lines well marked.

Surface dull or chalky-white, except the glistening protoconch.

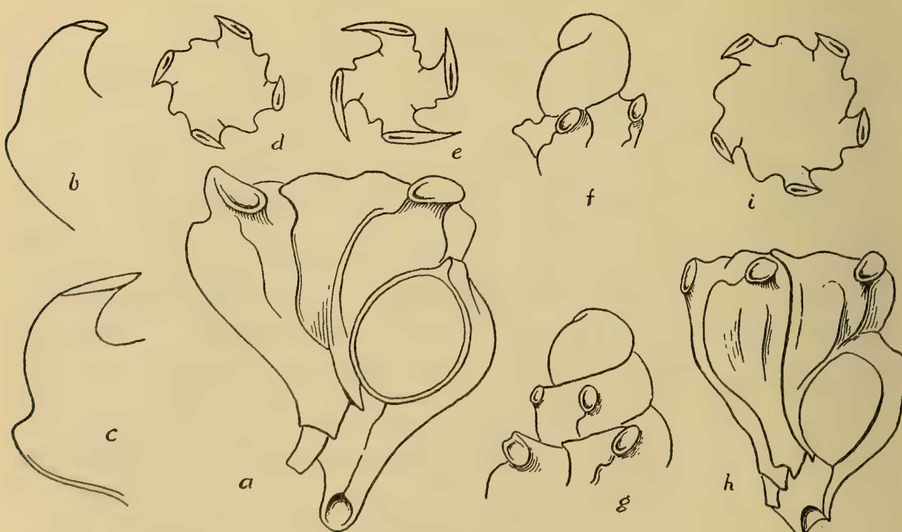


Fig. 46.

Typhis arcuatus Hinds. (*a*) body whorl. (*b*) anterior view of tube and varix. (*c*) the same of a specimen from Cape Point (S. Afr. Mus. no. A4945). (*d*), (*e*) diagrammatic apical views of normal specimen, and Cape Point specimen. (*f*), (*g*) two views of protoconch. *T. pentaphasios* n. sp. (*h*), (*i*) body whorl, and diagrammatic apical view.

Agulhas Bank, 40–45 fathoms (Hinds); 35° 16′ S. 22° 26′ E., 155 metres, and 35° 19′ S. 20° 12′ E., 126 metres (Thiele).

Off Cape Point, 123 fathoms; off Cape St. Blaize, 125 fathoms; off Cape Recife, 124 fathoms, juveniles; off East London, 43 fathoms (S. Afr. Mus. P.F. coll.).

Living: off Cape Point, 380–475 fathoms, one; off Cape St. Blaize, 55 fathoms, one (S. Afr. Mus. P.F. coll.).

Remarks. One specimen from off East London, although 5-whorled, is smaller than the others (15 × 6 mm.), and appears proportionately narrower because the tubes are curved upwards towards the apex; in typical specimens they project obliquely upwards. In two examples from off Cape Point, 123 fathoms, the tubes on the last whorl are very broad (transversely), complanate, and splayed outwards almost horizontally (fig. 46(*c*), (*e*)). The rather striking appearance thus produced might seem to indicate a different species, but the tubes become horizontally expanded only on the last whorl.

Five specimens have the varices carinate, with an obscure shoulder at the top defining the shallow notch at base of tube. In the narrow East London specimen the shoulder and notch are evanescent, and the last 3 varices become progressively less carinate, in fact the last is broadly rounded. In another East London example all the varices are broadly rounded, but those on the early whorls have a faint carination on the hinder side.

The length of the tubes is no criterion as they are subject to wear and corrosion.

Two juveniles with protoconch plus 1½ whorls, 3·5 mm. long, and two with protoconch plus 3 whorls, 7 mm. long., have been examined.

The animals of the two living *Pieter Faure* specimens were not preserved.

Apparently there is no character by which *transcurrens*, Zanzibar Channel, 5° 27′ S. 39° 18′ E., 463–465 metres, can be separated except size: 6 whorls (i.e. protoconch plus 5) 13 × 6 mm. (excl. tubes). Thiele, however, recorded both species.

Sowerby compared *duplicatus* (1870. *Proc. Zool. Soc. Lond.*, p. 251, China) with *arcuatus*, both species having curved varices.

Typhis pentaphasios n. sp.

Fig. 46(*h*), (*i*)

Protoconch corroded. Postnatal whorls 4; 5 tubes and 5 varices on each whorl; tubes oval-subcircular, with a broadly rounded rib below extending to the suture; varices broadly rounded, midway between tubes and growth-lines, profile evenly curved, not shouldered; peristome not quite continuous where the varix from the tube impinges upon it. 11 (incl. corroded protoconch) × 5·5 mm. White.

Off Cape Point, 660 fathoms, two dead (S. Afr. Mus. A4949. P.F. coll.).

Tritonalia puncturata (Sow.)

Figs. 40(*c*), 47(*a*)

1886. Sowerby. *J. Conch.*, v, p. 2 (*Cominella p.*).
1892. id. *Mar. Sh. S. Afr.*, p. 11, pl. 1, fig. 9 (*Cominella ? p.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 53, pl. 12, no. 393 (*Cominella p.*), and p. 53, pl. 12, no. 394 (*bipartita* color. var.).

Protoconch 2 whorls, alt. and diam. 0·5 mm., smooth. Postnatal whorls 6. Axial ribs on 1st whorl 15, on 2nd and 3rd 15–16, on 4th 17–18, but becoming fused one with another and obsolete on later whorls. Spiral lirae on 1st whorl 3, on 2nd 4, on 3rd 5, on 4th and 5th 6–7, the lower 2 stronger than those above and forming the peripheral shoulder, also usually a finer lira below the periphery, on 6th whorl 5 (6) fine, 2 stronger peripheral, and 2 subperipheral lirae. The sculpture on 1st and early part of 2nd whorl is cancellate, but thereafter the spirals predominate, especially the two peripheral ones; the groove between these two foveolate. On base 10–11 additional lirae, with punctate intervals. Canal open. 20 (without protoconch) × 9 mm.

Operculum oval, nucleus near outer margin below middle.

Buff or brownish, with darker axial streaks, or darker above and below the peripheral lirae, or dark above and pale below, or vice versa, lirae on body-whorl often spotted.

Radula with *c.* 180 rows, central plate with median cusp arising near front margin, 2 large submedian cusps on hind margin with 2–3 denticles between each of these and the median cusp.

False Bay, Hermanus, Still Bay, Mossel Bay, Port St. Johns (S. Afr. Mus.).

Living: west coast of Cape Peninsula (S. Afr. Mus.); Jeffreys Bay (St. Francis Bay), Knysna estuary, Mossel Bay, Breede River mouth (U.C.T.).

Remarks. The bicarinate and foveolate periphery is characteristic, as also are the finer lirae above the strong peripheral lirae. Some variation may occur: occasionally one of these finer lirae may be stronger than the others, almost as strong as the peripheral lirae.

Juveniles (5 mm.), especially slender forms, before there is a clear distinction between the fine upper lirae and the strong peripheral ones, are liable to confusion with *Trophon acutispira*. The axial ribs and the additional lirae on base are a little more numerous in *puncturata*.

Tritonalia scrobiculata (Dnkr.)

Fig. 47(*b*), (*c*)

1846. Dunker in Philippi. *Abbild. Beschr. Conch.*, ii, p. 118, pl. 3, fig. 4 (*Fusus s.*).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 2 (*Murex ? Ocinebra s.*).
1892. id. ibid., p. 2, pl. 1, fig. 1 (*Murex babingtoni*).
1892. id. ibid., p. 2, pl. 1, fig. 2 (*Murex crawfordi*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 75 (*crawfordi*) and p. 76 (*scrobiculata* and *babingtoni*).

Protoconch $1\frac{1}{2}$ (2) whorls, alt. 0·75, diam 0·5 mm., smooth. Postnatal whorls 4 ($4\frac{1}{2}$). Axial ribs on 1st whorl 11–12, on 2nd 12–14, on 3rd 15–16, on

last whorl *c.* 16–18 (but may occasionally be only 12); between suture and upper peripheral lira growth-lines form more or less distinct pliculae corresponding with the squamous nodules on the lira, usually sinuous, and more or less raised into vaulted squamulae; when strongly developed this series of squamulae forms the first of the 3 spiral lirae characteristic of *crawfordi* (fig. 47(*c*)); sometimes there are 2 such lirae, or, on the 4th whorl 3, so that the profile of 3rd whorl shows 4, that of 4th whorl 5 spiral lirae (*babingtoni*). The squamous nodules on the 2 strong peripheral lirae are very variable in strength. The foveoles between the lirae are usually nearly square, but may be transversely oblong when the number of ribs is reduced. On base 6 additional lirae, the 4th usually the smallest.

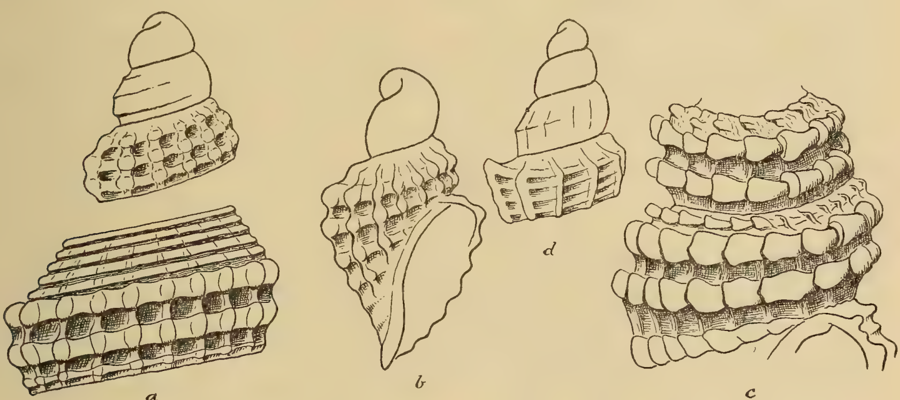


Fig. 47.

(*a*) *Tritonalia puncturata* (Sow.), 5th whorl, and protoconch. (*b*) *T. scrobiculata* (Dnkr.), protoconch. (*c*) 3rd and 4th whorls showing transition to 3-lirate *crawfordi*. (*d*) *T. kieneri* (Rve.).

Sometimes the spiral lirae are scarcely thickened and only feebly nodulous, consequently the axial ribs in the sulci are more distinct, and the sculpture more obviously cancellate. Worn examples of *babingtoni* appear distinctly cancellate.

The outer lip may be thickened, with 4–6 denticles within at the margin, but only when fully adult. Canal open. 15 × 7·5 (8·5) mm.; Turton: 22 mm. ? typ. err.

Operculum oval, nucleus near outer margin below middle.

Buff or brownish.

Radula with *c.* 150 rows, similar to that of *puncturata*.

Table Bay and west coast of Cape Peninsula, False Bay to Port Alfred, and Tongaat (Natal) (S. Afr. Mus.).

Off Knysna, 46 fathoms; off Keiskamma River, 33 fathoms; off East London, 32 fathoms (S. Afr. Mus. P.F. coll.).

Living: Langebaan (Saldanha Bay), and False Bay (U.C.T.).

Remarks. A common and distinct but variable species, which, it is not surprising, has been described from beach-worn specimens under three separate names.

Tritonalia purpuroides (Dnkr. MS.) (Rve.)

Dunker. MS. (as var. of *scrobiculatus*).

1845. Reeve. *Conch. Icon.*, Murex no. 158, pl. 32.
1848. Krauss. *Südafrik. Moll.*, p. 112, pl. 6, fig. 14 (*Murex dunkeri*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 25 (*Murex p.*).
1925. Thiele. ibid., xvii, p. 168 (*Murex p.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 76.

Protoconch $1\frac{1}{2}$ whorls, alt. and diam. 0·5 mm., smooth. Postnatal whorls 4–5. Axial ribs on 1st whorl 11, on 2nd 11–12, on 3rd (13) 12–11, on 4th 10–9 (8), on 5th 9–8. Spiral lirae 2 strong ones forming the peripheral shoulder; on base 6–7 additional lirae, often between the lower peripheral and the 1st basal lirae a thin lira, and often a similar one between 1st and 2nd basal lirae. Space between suture and upper peripheral lira smooth except for the fine growth-lines and axial plicae, the latter never squamulose; sometimes indications of 2 (very occasionally 3) fine spiral lirae between, but not crossing, the axial plicae. Intersections of axial ribs and peripheral lirae nodulous, or raised into pseudo-squamae (not or scarcely vaulted or hollowed in front). Basal lirae broader than the intervals, often very broad so that the intervals are mere striae. Outer lip in adult thickened, with 6–7 denticles or plicae within. Canal open. 15 × 7 mm.

Beach examples: white, often a faint brown band around middle of whorl, best seen within the aperture.

Cape, Port Elizabeth (Krauss, Bartsch, Sowerby); Port Alfred (Turton: only one specimen). Agulhas Bank, 35° 29′ S. 21° 2′ E., 102 metres, and 34° 51′ S. 19° 37′ E., 80 metres (von Martens).

Dassen Island, west coast of Cape Peninsula, and Kalk Bay (False Bay) (S. Afr. Mus.).

Remarks. Has not been taken alive. Apparently does not occur farther east than Port Elizabeth, though Turton claimed to have found one specimen at Port Alfred.

With fewer axial ribs than *scrobiculata*, especially on the last whorl. Most specimens, especially the extreme forms of the two species, are easily separable; but occasionally a specimen occurs which appears transitional and difficult to assign to one or the other. The absence, however, of squamulae between the suture and the shoulder lira seems to be a constant feature of *purpuroides*.

Tritonalia kieneri (Rve.)

Fig. 47(*d*)

1845. Reeve. *Conch. Icon.*, iii, Murex sp. 172 (*Murex k.*).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 60 (*Tritonalia k.*).

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 168, pl. 30 (18), fig. 9 (*Murex k.*).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 76.

Protoconch 2 (2½) whorls, alt. 1, diam. 0·8 mm., smooth. Postnatal whorls 4; axial ribs on 1st whorl 10–11, on 2nd 11, on 3rd and 4th 10–11 (3rd whorl in two slender specimens with only 9 ribs), from suture to suture and extending across base, including the groove, to rostrum; spiral lirae one peripheral on first half, 3 on later half of 1st whorl, 3–4 on 2nd whorl, 4 on 3rd and 4th whorls, on base 3 additional lirae followed by a deep groove, then 2 nodose lirae on rostrum; this groove forming a notch in outer lip is already developed on the 2nd whorl in the smallest specimen examined 4·5 mm. long. Canal narrow but not closed. 18 mm. (Turton). 12–13 mm. with worn apices (S. Afr. Mus.). Plump and slender examples (with 3 whorls): 8 × 4, 9 × 4, 9 × 4·5 mm.

Natal and Algoa Bay (Sowerby); Port Alfred (Bartsch, Turton); St. Francis Bay, 80 metres (Thiele); Still Bay and False Bay (S. Afr. Mus.).

Tritonalia sperata (Cossm.)

Fig. 48

1904. Smith. *J. Malac.*, xi, p. 30, pl. 2, fig. 11 (*Fusus cingulatus*, non Sowerby 1832).
1921. Cossmann. *Rev. Crit. Paléozool.*, xxv, p. 181 (*Fusus s.*).
1931. Tomlin. *Ann. Natal. Mus.*, vi, p. 434 (*Fusinus s.*).
1933. Turton. *Mar. Sh. Pt. Alfred*, p. 50 (*Fusus speratus* Crossman [*sic*] typ. err.).
1957. Barnard. *J. Conch.*, xxiv, p. 180, fig. (radula) (*Latiaxis fritschi*, non von Martens).
1959. id. ibid., xxiv. p. 327.

Protoconch 2 whorls, alt. 1–1·25, diam. 1·3–1·5 mm., smooth, junction with 1st postnatal whorl marked by several fine pliculae. Postnatal whorls 5, profile convex, in later whorls bluntly shouldered; axial ribs on 1st whorl 15–14, on 2nd 14–13, on 3rd 13–12, on 4th 11–10, on 5th 9–8, from suture to suture until 3rd whorl, thereafter petering out above and below the periphery where they form blunt rounded knobs, especially prominent on the body-whorl; crossed by spiral lirae 3 on 1st whorl (uppermost feeble at start), increasing to 4–6 on 2nd whorl, and very numerous on later whorls, *c.* 18–20 on 5th whorl; on 3rd whorl peripheral lira usually thicker than the others and rather prominent; on base *c.* 25 additional lirae (some being very fine intermediaries), on upper part of base one lira (usually the 5th) stronger than the others, forming a costa, rostrum costate; all the lirae minutely squamulose. Columella curved, its edge free and anteriorly produced over, but not completely closing the canal. 24 (apex missing, only 3rd–5th whorls present) × 15 mm. Smith: 28 × 14 mm.

Operculum oval, nucleus on outer margin below middle.

Grey with a rosaceous or violaceous tinge (U.C.T. specimen); fawn or buff (P.F. specimens, several years in alcohol). Beach specimens pinky-orange or salmon, the protoconch more deeply coloured.

Radula with at least 340 rows, central plate with median cusp arising from front margin, not extending as far as side cusps, which have one denticle on inner margin and 2–3 externally, postero-lateral corner of base acute, lateral plate moderately stout.

Dead: Port Alfred (Smith, Bartsch, Turton, S. Afr. Mus.).

Living: off Cape Morgan, 36 fathoms; off East London, 34–47 fathoms; Mossel Bay, 16 fathoms (S. Afr. Mus. P.F. coll.). Mossel Bay (U.C.T.).

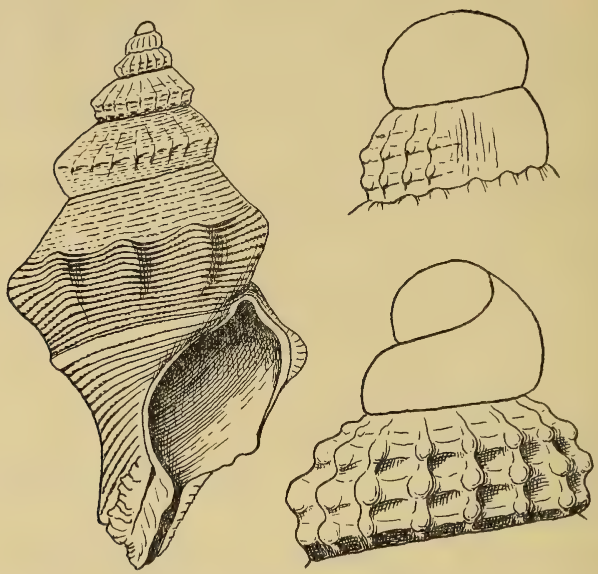


FIG. 48.
Tritonalia sperata (Cossm.).

Remarks. The costa on base (Smith: infraperipheral) is scarcely visible on 3rd whorl, feeble on 4th, and only becomes well developed on the 5th, and even then is variable in strength.

Gen. THAIS Bolten

1919. Cooke. *Proc. Mal. Soc.*, xiii, p. 91, figs. (radulae).

Thais cingulata (Linn.)

Fig. 49(*f*)

1771. Linne. *Mantissa*, ii, p. 549 (*Buccinum c.*).
1816. Lamarck. *Tabl. Encycl. Meth.*, pl. 422, figs. 4*a*, *b*, and Liste, p. 5 (*Triton trochlea*).
1822. id. *Anim. sans Vert.*, vii, p. 248 (*trochlea* and *clavus*).
1848. Krauss. *Südafrik. Moll.*, p. 118.
1859. Chenu. *Man. Conchyl.*, i, fig. 805.
1919. Cooke. loc. cit., p. 94, fig. 12 (radula).

Protoconch 1½ whorls, alt. 1, diam. 1–1·25 mm., smooth. Postnatal whorls 5, 1st demarcated from protoconch; axial ribs on 1st whorl 19–20, closer together at start than on later part of whorl, on 2nd and 3rd whorls 18–20, thereafter becoming irregular and intermixed with the finer growth-lines; spiral keels 2 on first part of 1st whorl, becoming 3 on later part, 3 on 2nd whorl, the upper one forming a shoulder girdle, the middle one peripheral, the lower one smaller and forming a suprasutural lira often concealed by the succeeding whorl; 3rd whorl with typically 3 keels, 4th and 5th with typically 3 or 4 (4 keels may develop sometimes on later part of 3rd whorl); additional lirae may develop on 4th and 5th whorls (sometimes on later part of 3rd) between suture and the shoulder keel, between each pair of keels, and also on base, or in the extreme non-cingulate form over the whole whorl and all whorls except the 1st. Outer lip internally plicate or grooved (or both), corresponding with the external girdles and the presence or absence of lirae. 41 × 23 mm. (unicingulate); 35 × 21 mm. (tricingulate); 20 × 13 and 20 × 10 mm. (typical). Smallest examples seen (protoconch plus 2 whorls) 4·5–5 mm. long.

Operculum oval-oblong, nucleus at outer margin, without distinct transverse oval lines.

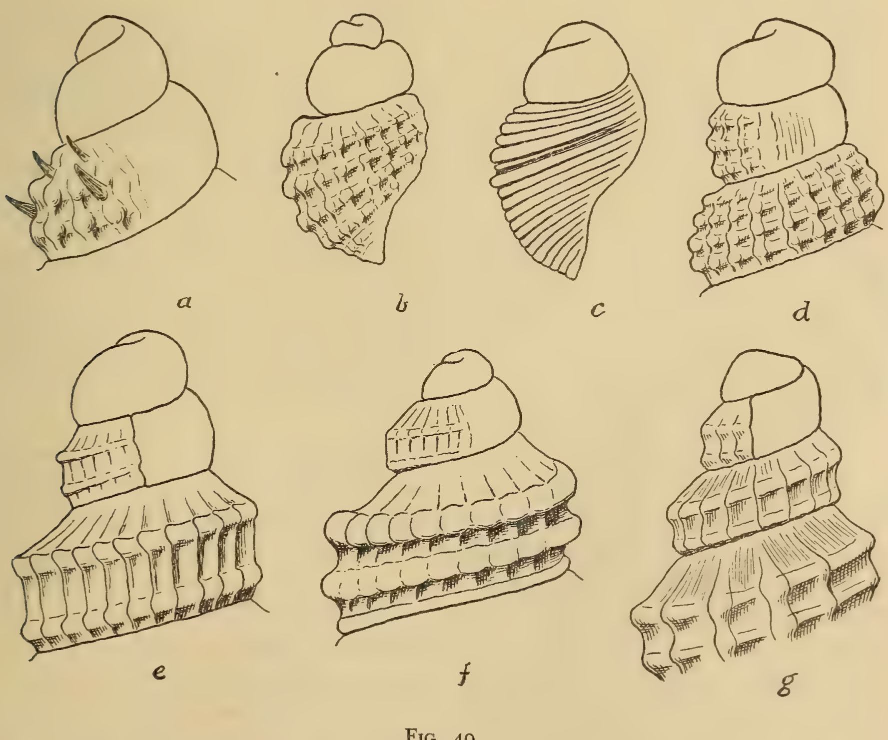


FIG. 49.

(*a*), (*b*) *Thais squamosa* (Linn.), with subscalariform aberration. (*c*) *T. capensis* (Petit). (*d*) *T. wahlbergi* (Krss.). (*e*) *T. dubia* (Krss.). (*f*) *T. cingulata* (Linn.). (*g*) *T. castanea* (Küster).

Grey, buff, or dirty white, operculum horny.

Radula with *c.* 165 rows (shell 10 mm.), *c.* 310 rows (shell 30 mm.), central plate with median cusp longer than side cusps, latter with one denticle on inner margin and 1–2 externally, postero-lateral corner of base acute, lateral plate rather slender.

Table Bay and Dassen Island; False Bay (S. Afr. Mus.).

Living: Port Nolloth (U.C.T.).

Remarks. Krauss gave Natal as well as the Cape as the habitat, but except for Sowerby's (1892) solitary record from Port Elizabeth, there are no records and no examples in S. Afr. Museum from any locality east of False Bay. Dr. Muir did not find it at Still Bay. The Port Elizabeth record is probably another instance of 'domicile of the collector, not of the mollusc'.

The axial ribs are entirely subordinate to the spiral keels on the 2nd and following whorls, but strongly enough developed on 2nd and 3rd whorls to form a clathrate sculpture. On the early whorls the keels are slightly nodular at the intersections, and on later whorls successive major growth-lines (or temporary stoppage of growth) are indicated by slightly irregular junctions.

The variable development of the girdles on the later whorls is even more striking in this species than in *Burnupena cincta* (p. 160). Krauss stated that the girdles varied from 1–4, and sometimes there were none at all. Possibly this statement has acted as a warning to later authors not to give varietal or specific names to the several forms; the extreme forms—5-cingulate (not mentioned by Krauss) and non-cingulate—are certainly very different in appearance.

When well developed (and unworn) the girdles are often very strong, with their upper and lower margins curling over; they may vary in width; and they may also be nearly flat, with little relief above the general surface of the shell, thus grading into the non-cingulate form. When the girdles are suppressed, the lirae are better developed. The non-cingulate form is wholly lirate, the lirae being equally regular in width throughout, or the girdles may be just indicated by slightly wider lirae. In some examples the lirae supersede or obscure the bicingulate and clathrate sculpture on the 2nd whorl which is characteristic of the typical form.

The three hundred (308) available specimens (most of them from a private collection, and probably from Table Bay or the west coast of the Cape Peninsula) seem to show that the tricingulate form is the commonest (185 specimens), the quadricingulate the next commonest (91); there are 12 bicingulate, 8 unicingulate, 6 non-cingulate, and 4 (all large) quinquecingulate. Two others are tricingulate, but the later part of the 4th whorl (? due to injury) suddenly loses one girdle, in one case the 1st, in the other the 3rd girdle. The 12 bicingulates include eleven with 1st and 2nd girdles, but one with 2nd and 3rd girdles; the 8 unicingulates include 2 with the 2nd girdle and 6 with the 1st girdle. There are no unicingulate examples in which the only remaining girdle is the 3rd or 4th.

The non-cingulate form has some similarity with *wahlbergi*, but is distinguished by smaller protoconch, the bicingulate 2nd whorl, and the absence of axial ribs on later whorls.

It also resembles even more closely some froms of *dubia* (e.g. Oudekraal, p. 223), but the protoconch and 1st whorl, and the whole spire, are broader.

Krauss (loc. cit., p. 118) recorded *succincta* from the Cape, but probably Baron von Ludwig's collection contained shells from various localities and possibly not always with locality labels. Lamarck's figures (1816. *Tabl. Encycl. Meth.*, pl. 398, figs. 1*a*, 1*b*) show 8 girdles on the body whorl. Sowerby (1892, p. 13) said the species lives at Madagascar and other eartern localities.

†*Thais praecingulata* (Tomlin MS.) Haughton

1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 48, pl. 5, figs. 6–10.

Fossil, Pleistocene: Alexander Bay, Namaqualand; and Rietvlei, Bredasdorp.

A large species: 95 (apex missing) × 65 mm.

Thais squamosa (Lam.)

Fig. 49(*a*), (*b*)

1816. Lamarck. *Tabl. Encycl. Meth.*, pl. 398, figs. 2 *a*, *b*., and Liste, p. 2 (*Purpura s.*).
1832. Blainville. *Nouv. Arch. Mus. Paris*, i, p. 251, pl. 12, fig. 6 (*Purpura clathrata*).
1903. Smith. *Proc. Mal. Soc.*, v, p. 376 (says *clathrata* is juv.).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 78, also p. 78, pl. 18, no. 565 (*sculpturata*, the right-hand figure, ? the left-hand figure).

Protoconch 2–2½ whorls, alt. and diam. 1 mm. (sometimes alt. 1·3 mm.), smooth. Postnatal whorls 6, 1st sharply demarcated from protoconch. Axial ribs on 1st whorl 18–19, on 2nd 19–20, increasing to 22–25 or more on 5th whorl, where they become confused with the growth-lines, from suture to suture and extending across base; spiral lirae on 1st whorl 2 (3 towards end of whorl, or when not covered by 2nd whorl), on 2nd 3–4, on 3rd 4–5, on 4th and 5th 5, with intermediaries, on base 7 additional lirae with intermediaries, the 3rd (sometimes 2nd) strong and often forming a costa on the body-whorl; intersections of ribs and lirae nodular, on later whorls the nodules transversely oblong, often subsquamose and hollowed in front. Rostrum squamose; aperture (at certain stages of growth) plicate internally. Periostracum with short spiniform processes. 61 (protoconch and 2 whorls missing) × 40 mm.; 44 × 27 mm.; 39 × 24 mm. Protoconch plus 1st whorl 2·5 mm. long.

Operculum oval, nucleus on outer margin below middle.

Brown, uniform or with darker axial streaks, sometimes whitish with brown spiral bands, or bright brown markings and axial streaks.

Radula with *c.* 190 rows (shell 20 mm.), *c.* 285 rows (shell 44 mm.) central plate with median cusp not much longer than side cusps, latter with a denticle

on inner and outer side, margin external to side cusp with 2–3 denticles, lateral plate moderately stout.

Cape and Natal (Krauss); Port Elizabeth and Port Alfred (Sowerby, Bartsch, Turton); Table Bay and Dassen Island (S. Afr. Mus.).

Living: Lambert's Bay, False Bay, and 34° 7′ S. 25° 46′ E., 41 fathoms (U.C.T.). Still Bay (S. Afr. Mus.).

Remarks. Plump and slender forms occur: 26 × 16 mm., and 27 × 14 mm.; 52 × 35 mm., and 52 × 28 mm.

One specimen, 45 × 30 mm., has unusually strong spiral lirae and axial ribs; this is particularly noticeable on the 4th and the beginning of the 5th (body) whorl, producing a very strong clathrate sculpture with deep intervening pits.

The protoconch sometimes sits very prominently on the first whorl.

Thais capensis (Petit)

Figs. 40(*f*), 49(*c*)

1848. Krauss. *Südafrik. Moll.*, p. 117 (*luteostoma*, non Desh.).
1852. Petit. *J. de Conchyl.*, iii, p. 162, pl. 7, fig. 6 (*Purpura c.*).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 14 (? var. of *luteostoma*).
1903. Smith. *Proc. Mal. Soc.*, v, p. 376, pl. 15, fig. 21 (*Purpura pura*).
1904. id., *J. Malac.*, xi, p. 32, pl. 2, fig. 15 (*Purpura texturata*).
1919. Cooke. loc. cit., p. 93 (radula).
1923. Tomlin. *J. Conch.*, xvii, p. 47 (*pura* and *texturata* = *capensis* juv.).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 76, pl. 18, no. 554, p. 77 (var. *luteostoma* Desh.), p. 77, pl. 18, no. 556 (*albolineata*), and p. 77 (texturata).
1934. Nardini. *Palaeontogr. Ital.*, 34 (1933), p. 205, pl. 15 (2), figs. 15*a–d* (*Purpura succincta* Mart. var. *natalensis*).

Protoconch 1½–2 whorls, alt. 1·75, diam. 2 mm., smooth. Postnatal whorls 5, 1st not clearly demarcated from protoconch. Spiral lirae on 1st whorl 7, the 5th stronger than the others, on 2nd whorl 10, the 6th and 10th stronger, 6th in middle of whorl, 10th more or less concealed by succeeding whorl (but visible on body-whorl); on 3rd and following whorls lirae increase in number by interpolation; 2 additional strong lirae on base; from 3rd whorl the 2 peripheral lirae become gradually nodose, 9–11 nodules, on last whorl in large specimens 8–9 large blunt nodules, those of the upper series alternating with those of the lower series; growth-lines in interstices between lirae well marked (in fresh specimens) forming a punctate-striate sculpture. 60 (protoconch missing) × 34 mm., 55 (protoconch and 1st whorl missing) × 31 mm., 51 (protoconch and first 3 whorls missing) × 34 mm. (knobs excluded in measurements of width); 41 (incl. protoconch) × 23 mm. Protoconch plus 1st whorl 4·5–5 mm. long.

Operculum oval-oblong, nucleus on outer margin below middle, without distinct transverse oval lines.

Buff, brown, grey, the peripheral lira (lirae) with brown spots corresponding with the knobs, aperture yellowish with brown bands corresponding with

the spaces between the external lirae (or castaneous brown with 4 yellow stripes); worn shells brown or yellowish, with brown spots of the lirae; protoconch whitish, 1st and 2nd whorls sometimes with brown axial streaks; operculum horny-brown. One specimen (S. Afr. Mus.) uniform pale buff, almost white, operculum horny-brown.

Radula with *c.* 95 rows (shell consisting of protoconch plus 1st whorl), at least 160 rows (shell 36 mm.), central plate with median cusp much stronger than side cusps, latter with or without denticle on inner margin, externally no denticles or wrinkles, lateral plate rather stout.

Natal (Krauss, Smith, S. Afr. Mus.); Port Alfred (Smith, Bartsch, Turton, S. Afr. Mus.); Still Bay (S. Afr. Mus.). Cape Agulhas, collected by Verreaux (Petit).

Living: Scottburgh, Natal (Cooke). Off East London, 195 fathoms (S. Afr. Mus. P.F. coll.). Mossel Bay and East London (U.C.T.).

Remarks. In 1886 Sowerby did not agree with Tryon in regarding *capensis* as a variety of the Japanese *luteostoma*; but in 1892, having seen 'an undoubted *luteostoma*' from Port Elizabeth, he was doubtful and remarked that the typical forms were very unlike. As the original provenance of the Port Elizabeth *luteostoma* is very doubtful, and cannot be checked, the Japanese species should be excluded from the South African fauna-list. According to Cooke (1919) there are slight differences in the radulae of the two species. My specimen of *capensis* confirms Cooke's description.

The protoconch is a little larger than that of *Burnupena cincta* and the lirae on 1st portion (or first portion of 1st postnatal whorl) are not so regular in size and spacing, the 5th and 7th lirae being slightly thicker; very fine growth-lines foreshadow the sculpture on the later whorls.

Turton's *albolineata* seems to be merely a very worn specimen.

Nardini had one specimen, 25 × 16 mm., from Umkomaas. Fortunately he gave an enlarged figure (photographic) of the sculpture, which puts the identity with *capensis* beyond doubt.

Thais dubia (Krauss)

Figs. 40(*g*), 49(*e*)

1836. Kiener. *Coq. viv.*, pl. 40, fig. 94 *a* (*Purpura lagenaria* var.).
1848. Krauss. *Südafrik. Moll.*, p. 117.
1889. Sowerby. *J. Conch.*, vi, p. 148 (*scobina*, non Q. & G.).
1892. id. *Mar. Sh. S. Afr.*, p. 14 (*cataracta*, non Chemn.).
1910. Schwarz. *Tr. Geol. Soc. S. Afr.*, xii, p. 114 (*Purpura scobina*).
1919. Cooke. loc. cit., p. 93 (radula) (*cataracta*, non Chemn.).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 77 (*cataracta* and *cataracta dubia*).
1932. id. ibid., p. 77, pl. 18, no. 561 (*pyramidalis* = juv.), and p. 78, pl. 18, no. 562 (*rufanensis* = juv.).
1932. Haughton. *Tr. Geol. Soc. S. Afr.*, xxxiv (1931), p. 47.

Protoconch $1\frac{1}{2}$ whorls, alt. 1, diam. 0·75 mm., smooth. Postnatal whorls 5, 1st marked off from protoconch by a fine plica, or indicated only by the

start of the spiral lirae and the growth-lines. Axial ribs on 1st whorl 15–16, feeble at first and not always distinct from the growth-lines, on 2nd whorl 13–14, on 3rd 11–12; the ribs entirely subordinate to the spiral lirae but forming nodules or vaulted scales or undulations on the lirae at the intersections, usually not continued across base, on later whorls not distinct from the growth-lines; spiral lirae 2 on 1st, 2nd and 3rd whorls, rather far apart, becoming obscure, but usually traceable in good specimens on 4th and 5th whorls, 4–5 additional lirae on base; from 3rd whorl onwards feeble intermediaries may develop: 1 or 2 between suture and 1st lira, one between the 2 peripheral lirae, and one between each pair on the base. 43 (protoconch and 2 whorls missing) × 28 mm., 41 (protoconch and 3 whorls missing) × 28 mm., 24 × 14·5 mm., 23 × 16·5 mm., 20 × 15 and 20 × 11 mm. Protoconch plus 1st whorl 1·75–2 mm. long.

Operculum oval-oblong, nucleus on outer margin, transverse oval lines (thickenings on internal surface) distinct.

Typically pale with dark brown or blackish axial flames from suture downwards, making spots on the lirae, in larger specimens becoming zigzag markings across nearly whole of body-whorl but leaving a more or less clear band around middle. Considerable variation in colour and pattern occurs. There may be dark disconnected irregular blotches, or spiral streaks only; or pale grey or buff with faint yellowish spiral bands; or orange-brown with chestnut spiral bands. Aperture castaneous with a pale band in middle, more distinct in adults than in juveniles; even in the pale almost unicolorous examples where the aperture is only suffused, the pale band is distinguishable though faint; the columella also is more or less suffused. Examples from Langebaan (Saldanha) have a very dark, almost purplish, aperture and columella.

Radula with *c.* 95 rows (shell 13 mm.), *c.* 270 rows (shell 29 mm.), central plate with median cusp longer than side cusps, latter with a denticle on inner and usually also on outer margin, externally one denticle or none, postero-lateral corner of base pointed but not prominent, lateral plate rather stout.

Fossil, Quaternary: Namaqualand (Haughton); Sedgefield near Knysna (Martin); Port Elizabeth (Schwarz).

Cape (Krauss); Port Elizabeth (Sowerby); Port Alfred (Bartsch, Turton); Table Bay, False Bay, Still Bay (S. Afr. Mus.).

Living: Lambert's Bay, Langebaan (Saldanha Bay), west coast of Cape Peninsula, False Bay, Knysna (U.C.T.).

Remarks. Juveniles are slender with sharply pointed spire (*pyramidalis*); this slenderness may be maintained in later whorls, but is usually succeeded by plumpness.

Young specimens with well-marked nodules or vaulted scales on the lirae are different in appearance from smoother adults. An 18 mm. example from sheltered water in Knysna estuary (U.C.T.) has all the growth-lines very well marked with free edges, and the temporary outer lips form squamate projections on each lira.

Sculpture and coloration are often obscured by corrosion and algal growth.

Specimens collected at Oudekraal (west coast of Cape Peninsula) (U.C.T., also K.H.B.) with 4 whorls, 16–17 mm. long, are uniform pale buff or greyish-white, with pale violaceous columella and aperture, the pale internal band faintly visible. Their chief peculiarity, however, is the nearly equal size of the main and intermediary lirae, especially on 4th whorl; the 2nd and 3rd whorls might be described almost as lirate and the body-whorl of one of them is definitely quadrilirate, with 9 lirae on base. One of them fortunately retains the prominent protoconch and narrow bilirate 1st whorl, and thus (together with the pale band in the aperture) indicate their specific identity. The operculum has distinct transverse oval lines.

A specimen in S. Afr. Mus. (Reg. no. 6620. 'South Africa') was identified by J. H. Ponsonby as the New Zealand *Purpura scobina* Q. & G., a species recorded by Sowerby from Port Elizabeth. This specimen, however, is merely a young *dubia*. Sowerby's identification was also probably wrong, and *Haustrum scobinum* should be deleted from the South African fauna-list.

Turton's *pyramidalis* is obviously a young *dubia*. Turton evidently did not realize the slenderness of this species when young; he gives the number of postnuclear whorls as 6, which seems to be either a misprint or a miscount: a specimen 15 mm. long should have 4 postnatal whorls. His *rufanensis* is a squat form of *dubia* (with apex worn).

Thais wahlbergi (Krss.)

Figs. 40(*h*), 49(*d*)

1848. Krauss. *Südafrik. Moll.*, p. 118, pl. 6, fig. 15 (*Purpura w.*).
1891. Smith. *Proc. Zool. Soc. Lond.*, p. 436, pl. 4, fig. 2 (*Coralliophila w.*).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 4 (*Euthria w.*).
1938. Bright. *Trans. Roy. Soc. S. Afr.*, xxvi, p. 62 (*Thais w.*).
1947. Stephenson. *Ann. Natal Mus.*, xi, pp. 273, 274 (*Cominella w.*).
1956. Orr. *Proc. Ac. Nat. Sci. Philad.*, cviii, p. 250 ('*Purpura*' *w.*).

Protoconch 2 whorls, alt. and diam. 1·3–1·5 mm., smooth, prominent when not worn. Postnatal whorls 5½–6, profile convex, not or very feebly shouldered, 1st whorl sharply demarcated from protoconch. Axial ribs often obscure, on 1st whorl 14, on 2nd 12, on 3rd 12–11, on 4th 11–10, thereafter irregular and feeble, from suture to suture, obsolete on base even in juveniles; spiral lirae on 1st and 2nd whorls 3 (on 2nd whorl one or two feebler ones below suture), increasing by interpolation on later whorls, broader and narrower lirae more or less regularly alternating, or 2 fine lirae between a pair of broader ones, the intervals becoming very narrow, merely striae; when fresh and unworn the close-set lines of growth make the lirae crispate (Smith) or finely scabrous, and the striae punctate. Sculpture cancellate (transversely oblong hollows) on first 2 whorls, on later whorls spirally lirate/striate, with only feeble and irregularly spaced axial ribs. Rostrum rimate. Canal when fully developed nearly closed,

Outer lip sometimes thickened with a varix, internally plicate. 47 × 21 mm. Protoconch plus 2 whorls 5·5 mm.

Operculum oval, nucleus on outer margin near apex, oblique (not transverse) oval thickenings across centre of inner surface, not visible externally.

Grey or dirty whitish, operculum pale horny.

Radula very long, at least 360 rows, central plate with median cusp arising on front margin, side cusp with a denticle on inner margin and one or two denticles externally, lateral plate rather slender.

Animal cream-coloured, eyes very small, black.

Living: off Sea Point (Cape Town) (Smith; also S. Afr. Mus.); Oudekraal (west coast of Cape Peninsula), Langebaan (Saldanha Bay), and Port Nolloth (U.C.T.). Saldanha Bay (Orr).

Remarks. The fine crispate lirae, with intervening punctate striae, make a characteristic sculpture.

Plump and slender forms occur: 43 × 23, 46 × 22, 46 × 20 mm.

Apparently a west coast species. Krauss's locality 'Natal' has not been confirmed, and there are no records from any intermediate localities.

Sowerby put this species into *Euthria* in spite of Krauss saying the operculum was Purpuroid. According to the radula it can be included in *Thais*. Orr has suggested in or near *Urosalpinx*.

Thais castanea (Küster)

Figs. 40(*i*), 49(*g*)

1886. Küster. *Conch. Cab.*, p. 170, pl. 28, figs. 8, 9 (*Purpura c.*).
1886. Sowerby. *J. Conch.*, v, p. 3 (*Cominella unifasciata*).
1892. id. *Mar. Sh. S. Afr.*, p. 11, pl. 1, fig. 11 (*C. unifasciata*).
1897. id. *Append. Mar. Sh. S. Afr.*, p. 4 (*C. unifasciata* var. *concolor.*).
1938. Eyre and others. *Ann. Natal Mus.*, ix, p. 110 (*Cominella c.*).
1938. Peile. *Proc. Mal. Soc.*, xxiii, p. 99, fig. 35 (radula).

Protoconch 1½ whorls, alt. and diam. 0·75 mm., smooth. Postnatal whorls 5, start of 1st whorl distinct. Axial ribs on 1st whorl 10–11, but not very distinct, on 2nd and following whorls 10 (sometimes only 9), forming distinct blunt knobs at intersections with spiral lirae, more distinct on the upper than on the lower lira, often obscure on last part of 5th whorl, in fresh specimens the knobs are squamate, hollow in front; ribs not crossing base; spiral lirae on 1st and following whorls 2, the upper some little distance from the suture, the lower just above and often partially obscured by the succeeding whorl, sometimes a fine intermediary between the two; on base 4 additional lirae, often more distinct in juveniles than adults, sometimes with fine intermediaries; growth-lines producing a very finely striate appearance. Outer lip plicate internally. 15 × 7·5 mm. Protoconch plus 2 whorls 2·5 mm. long.

Operculum oblong-oval, nucleus on outer margin, no distinct transverse oval lines.

Castaneous-brown, usually with the protoconch and 1st whorl, or 1st and 2nd whorls, white; or brown with a white band in middle of body-whorl; or white with a brown band below the suture; or uniform white.

Radula with *c.* 130 rows, central plate with median cusp larger than side cusp, latter with denticle on inner margin, externally 2–3 denticles, lateral plate stout. Peile said the radula was shorter than those of many species of the family (*Thaididae*), only 88 rows. His examples were probably young.

Cape (Kuster), Natal (Sowerby), Port Alfred (Smith, Bartsch, Turton); Pondoland and Still Bay (S. Afr. Mus.).

Off Tugela River (Natal), 65–80 fathoms, one dead but fresh; off East London, 45 fathoms, dead but fresh; off Sandy Point (north of Kei River), 51 fathoms (S. Afr. Mus. P.F. coll.).

Living: East London, and Still Bay (U.C.T.).

Thais distinguenda (Dnkr.)

1852. Dunker. *Reise Novara. Moll.*, figs. 1–3.
1880. Von Martens. *Mauritius & Seychellen*, p. 236 (as var. of *hippocastanum*).
1919. Cooke. loc. cit., p. 95, fig. 4 (radula) (*intermedia*, 'usually regarded as var. of *hippocastanea*' [*sic*]).
1952. Satyamurti. *Bull. Madras Govt. Mus.*, n.s. I, 2, pt. 6, p. 167, pl. 16, fig. 5 (*intermedia*).
1952. Braga. *Anais Est. zool. Ultramar.*, vii, 3, pl. 3, fig. 4 (as *Ricinula tuberculata* Blainv.).

Radula with *c.* 250 rows (shell 28 mm.) to 290 rows (shell 38 mm.), central plate with median cusp longer than side cusps, latter with denticle on inner margin, 3 denticles or wrinkles externally, lateral plate moderately stout.

Living: Umpangazi (Zululand) (U.C.T.). Delagoa Bay and Mozambique Island (K.H.B. coll., and U.W.). Ponta do Ouro (Mozambique) (Braga).

Distribution. Nicobars, Mauritius, Indo-Pacific.

Remarks. The U.C.T. specimens came to me labelled *intermedia* (Kiener). Mr. Salisbury has identified a specimen as *distinguenda* (var. *savignyi* Desh.); and the specimens are here recorded under this name. Braga's illustration seems to agree with these specimens.

Von Martens regarded *distinguenda* as synonymous with *hippocastanum* (Linn.) var. *intermedia* (Kien.). He mentioned the variation in colour of the columella: dark with a white stripe (*intermedia*), brownish with paler patches (*hippocastanum* s.s.) whitish (*savignyi*). Some of the present specimens resemble *hippocastanum*, but most of them correspond better with *savignyi*.

*Thais bituberculari*s (Lam.)

1822. Lamarck. *Anim. sans. Vert.*, vii, p. 237 (*Purpura b.*).
1836. Kiener. *Coq. viv.*, p. 49, pl. 11, fig. 32.
1859. Chenu. *Man. Conchyl.*, i, fig. 803.
1919. Cooke. loc. cit., p. 92 (radula).
1938. Adam & Leloup. *Mem. Mus. Roy. Hist. Nat. Belg.*, H.S. II, 19, p. 169, pl. 7, figs. 7 *a, b*.

Radula with *c.* 195 rows, central plate with median cusp much stronger and longer than side cusps, a separate small denticle between median and side

cusps, externally 2 minute denticles or wrinkles, lateral plate rather stout.

Living: Delagoa Bay (U.W.).

Distribution. Karachi (Cooke). East Indies.

Thais gemmulata (Lam.)

1764. Linne. *Mus. Ulricae*, p. 636 (*mancinella* part).
1816. Lamarck. *Tabl. Encycl. Meth.*, p. 397, figs. 3 *a*, *b*, and Liste des planches, p. 2.*
1848. Krauss. *Südafrik. Moll.*, p. 117 (*mancinella*).
1880. Von Martens. *Mauritius & Seychellen*, p. 235 (*mancinella*).
1892. Sowerby. *Mar. Sh. S. Afr.*, p. 14 (*mancinella*).
1906. Hedley. *Proc. Trans. Linn. Soc. N.S.W.*, xxxiii, p. 457.
1913. Smith. *Proc. Mal. Soc.*, x, p. 288.
1919. Cooke. loc. cit., p. 92 (radula).
1938. Adam & Leloup. *Mem. Mus. Roy. Hist. Nat. Belg.*, H.S. II, 19, p. 170, pl. 7, fig. 6 (*mancinella*).
1956. Day & Morgans. *Ann. Natal Mus.*, xiii, p. 307 (*mancinella*).

Living: Durban Bay (Cooke, S. Afr. Mus., and U.C.T.); Umpangazi (Zululand) (U.C.T.); Delagoa Bay (U.W.).

Collected in Durban Bay by Burnup, and K.H.B. 'Fairly common' in the harbour entrance (U.C.T.). The large specimen (*v. infra*: *echinata*) was taken by the *Pieter Faure* at the jetty.

Distribution. Mauritius, Madagascar, Seychelles, Indo-Pacific.

Remarks. The large 6-whorled *Pieter Faure* specimen was returned by Sowerby labelled as *echinata* (Blainv.). As it differs from the smaller specimens only in having stronger tubercles I am assigning it to *gemmulata.*

In live shells (and in dried shells when wetted) the pale lirae on the apical whorls make a pretty contrast with the reddish ground colour.

One specimen in S. Afr. Mus. (? H.M.S. *Castor*, east coast of Africa), 5 whorls, 42 × 31 mm., has an extra series of low blunt knobs below the suture on 4th and 5th whorls, corresponding with the shoulder and peripheral knobs, 10 on 4th, 8 on 5th whorl.

Smith gave reasons for adopting Lamarck's name instead of *mancinella* Linn.

Thais (*Cymia*) *carinifera* (Lam.)

1822. Lamarck. *Anim. sans Vert.*, vii, p. 241 (*Purpura c.*).
1836. Kiener. *Coq. viv.*, p. 62, pl. 14, fig. 38 (*Purpura c.*).
1852. Souleyet. *Voy. Bonite*, ii, p. 603, pl. 40, figs. 4–6.
1911. Schepman. *Siboga Exp. monogr.*, xlix, p. 354.
1919. Cooke. loc. cit., p. 93 (radula).
1952. Braga. *Anais Est. zool. Ultramar.*, vii, 3, p. 77, pl. 3, fig. 6 (*Cuma c.*).

One somewhat worn specimen, 4 whorls, apex broken, 46 × 33 mm., dirty white, corresponding with Braga's figure except that the lira above the

* In the S. Afr. Mus. copy, which belonged to Swainson, the name 'mancinella' is written under fig. 3 in Swainson's handwriting.

peripheral tubercles becomes crested at the outer lip and thus forms a prominent tooth on the margin.

The specimen (S. Afr. Mus. A7688) is said to have come from Natal, but more probably it came from Delagoa Bay, whence Braga recorded the species.

Two young specimens, 22 (protoconch worn) × 15 mm., 4 postnatal whorls, from Inhambane (U.C.T.) seem to belong to this species. They have 8 tubercles on each whorl (the above larger specimen has 9), 8–9 main lirae between suture and peripheral tubercles, with intermediaries; numerous lirae on base, the strongest one running from top of aperture and carrying tubercles corresponding with the peripheral series; growth-lines crispate; costa on rostrum rounded (not sharply keeled). Greyish, columella whitish, aperture internally purplish-brown, operculum amber.

Radula with 180 and 220 rows (two radulae), central plate with median cusp very long and narrow, 3 times as long as side cusps, latter with denticle on inner side, externally 4–5 well-marked denticles, one or two of them ascending the cusp (cf. Cooke's description).

Distribution. Karachi, East Indies, Philippine Is.

Gen. Drupa Bolten

1919. Cooke. *Proc. Mal. Soc.*, xiii, p. 100 (radulae).

This Indo-Pacific genus extends down the east coast of Africa to Natal. The most southerly locality is Port Edward (living *squamosa*, U.C.T.). *D. alfredensis*, although named after Port Alfred, probably came from Natal (if it was a South African shell!). Sowerby's record of *tuberculata* (*granulata*) from Port Elizabeth is open to doubt; and Gould's record of *parvulum* from Simon's Bay (False Bay) is certainly not acceptable (possibly Gould may have had a *Tritonalia scrobiculata* or a young *Thais dubia*).

Drupa squamosa (Pease)

Fig. 50(*a*)

1868. Pease. *Amer. J. Conch.*, iii, p. 277, pl. 23, fig. 14 (*Sistrum s.*).
1919. Cooke. loc. cit., p. 101 (radula).

Radula with *c.* 190 rows, central plate with long narrow median cusp, side cusp with one denticle on inner margin, externally 3–5 denticles, ascending the cusp, lateral plate with base scarcely one-third width of central plate, blade slender.

Living: Durban and Scottburgh (Cooke); Port Edward, Umhlanga, and Kosi Bay (U.C.T.); Maxixe, Portuguese East Africa (U.C.T.); Mozambique Island (U.W.).

Distribution. Indo-Pacific.

Drupa anaxares (Duclos MS. Kiener)

1843. Kiener. *Coq. viv.*, vii, p. 26, pl. 7, fig. 17.
1919. Cooke. loc. cit., p. 105 (radula) (*Morula a.*).
1938. Adam & Leloup. *Mem. Mus. Roy. Hist. Nat. Belg.*, H.S. II, 19, p. 159, pl. 6, fig. 14 (*anaxeres*).

Living: Umkomaas, Natal (Cooke). Mozambique Island (U.W.).

Drupa granulata (Duclos)

Fig. 50(*b*)

1832. Duclos. *Ann. Sci. Nat.*, xxvi, p. 111, pl. 2, fig. 9 (*Purpura g.*).
1832. Blainville. *Nouv. Arch. Mus. Paris*, i, p. 204, pl. 9, fig.
1919. Cooke. loc. cit., p. 106 (radula) (*Morula g.*).
1938. Adam & Leloup. *Mem. Mus. Roy. Hist. Nat. Belg.*, H.S. II, 19, p. 159, pl. 6, fig. 13 (*tuberculata*).

Radula with *c.* 160 rows, central plate with strong median cusp, nearly twice as long as side cusps, latter with a denticle on inner margin, externally with one denticle, lateral plate with base about half width of central plate, blade slender.

Living: Isipingo, Natal (Cooke); Durban (S. Afr. Mus., and U.C.T.); Mozambique Island (U.W.).

Distribution. Indo-Pacific.

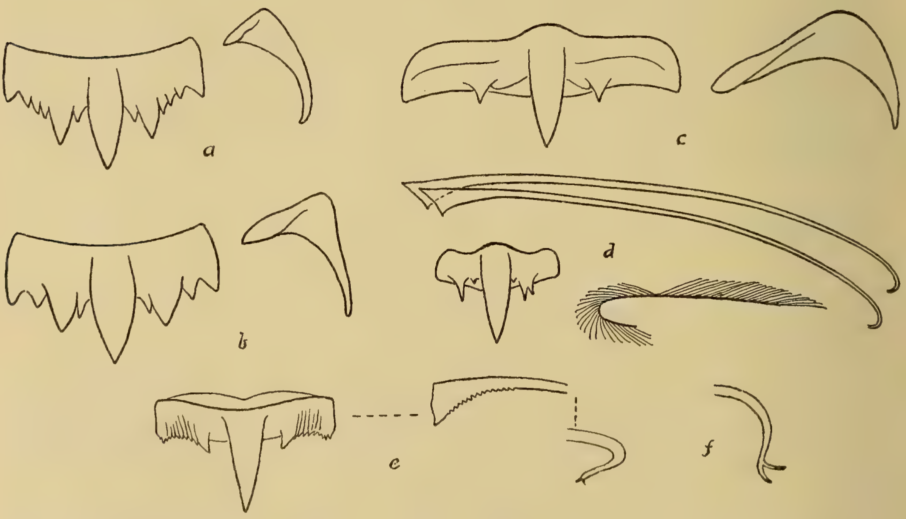


Fig. 50.

Central and lateral radula plates of (*a*) *Drupa squamosa* (Pease); (*b*) *D. granulata* Duclos; (*c*) *D.* (*Cronia*) *margariticola* Brod.; (*d*) *Drupella* sp. specimen C, with diagram of orientation of lateral plates on the basal membrane; (*e*) *Drupella* sp. specimen B; (*f*) *Drupella* sp. specimen A, apex of lateral plate.

Remarks. Cooke described a radula in the Gwatkin collection labelled *granulata* from Isipingo, and a radula of a Mauritian *tuberculata*, in both of which the median cusp of the central plate was shorter than the side cusps (this might apply to the much-worn plates at the front end of a radula). The present description is taken from specimens collected by myself at Durban, the shells of which correspond with shells identified by Burnup.

Drupa squamilirata (Smith)

Fig. 40(*e*)

1903. Smith. *Proc. Mal. Soc.*, v, p. 377, pl. 15, fig. 17 (*Sistrum s.*).

Protoconch 2 whorls, alt. and diam. 0·75 mm., smooth. Postnatal whorls 5, profile angularly shouldered in middle of whorl or slightly below; axial ribs 9 on 1st whorl, 9–10 on following whorls, from suture to suture, broad, the periphery an undulate outline in apical view, petering out on base; crossed by one peripheral lira on 1st and 2nd whorls, by the peripheral lira and one below it on 3rd, by 4 lirae above and one (or 2) below the peripheral one on 4th and 5th whorls, 9–10 additional lirae on base, with fine intermediaries. Growth-lines crispate. Costa on rostrum rounded. Columella rimate anteriorly. Canal open; outer lip internally plicate. 13 × 7 mm. Smith: 19 × 10 mm. White.

Operculum oval-reniform, nucleus in middle of outer margin.

Radula with *c*. 100 rows, central plate with median cusp much longer than side cusps, latter with denticle on inner margin, but no denticles externally, lateral plate rather slender.

Isipingo (Smith, coll. Burnup); Scottburgh (S. Afr. Mus., coll. Burnup).

Off Morewood Cove (near Umhloti, Natal), 27 fathoms, 4 alive; off Umhlanga River, 22–26 fathoms, 3 (one alive); off Tongaat River, 36 fathoms, one fragment (S. Afr. Mus. P.F. coll.). 29° 58′ S. 31° 02′ E., 49 metres (U.C.T.).

Remarks. In general appearance like the Mediterranean and West African *Trophon fusulus* (Brocchi) as figured by Knudsen (1956. *Atlantide Rep.*, 4, pl. 3, figs. 4, 5).

Subgen. *Cronia* H. & A. Adams

Drupa margariticola Brod.

Fig. 50(*c*)

1795. Chemnitz. *Conch. Cab.*, xi, p. 124, pl. 192, figs. 1851, 1852 (*Murex undatus*, part).
1832. Broderip. *Proc. Zool. Soc. Lond.*, p. 177 (*Murex m.*).
1919. Cooke. loc. cit., p. 107 (radula) (*Morula undata*).
1938. Adam & Leloup. *Mem. Mus. Roy. Hist. Nat. Belg.*, H.S. II, 19, p. 161, pl. 6, fig. 16.

Animal black. Radula with *c*. 135 rows, strongly 'chitinized', brown, blackish posteriorly, central plate very wide, median cusp much stronger than

side cusps, scarcely a trace of a denticle between them, lateral plate base wide, more than half width of central plate, blade shorter than base.

Durban, Delagoa Bay (Sowerby); Isipingo, Natal (S. Afr. Mus. coll. Burnup).

Living: Delagoa Bay, Nacala, and Mozambique Island (U.W.).

Distribution. Indo-Pacific.

Remarks. The radula of a Delagoa Bay specimen is quite different from that described by Cooke from Karachi and Isipingo specimens, and resembles that of *D.* (*Cronia*) *amygdalus* (Cooke, fig. 33).

Gen. Drupella Thiele

1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 171, figs. 3, 4 (radula) (as subgen.).
1929. id. *Handbuch*, i, p. 295, fig. 321 (radula) (as subgen.).
1939. Peile. *Proc. Mal. Soc.*, xxiii, pp. 273–6.

Distinguished by the slender elongate lateral plates of the radula; supposed to be an adaptation to feeding on certain kinds of coral (Cooke, 1895).

Drupella sp.

Fig. 50(*d*)–(*f*)

Three shells from Delagoa Bay (U.W.), 16–18 × 10 mm., are so corroded and overgrown with calcareous growth that identification is almost impossible (cf. Peile). They seem, however, to agree with Scottburgh (Natal) examples in S. Afr. Mus. collected and named by Burnup as *elata* Blainv. The outer lip in all of them is internally denticulate, and the columella feebly granulate at the anterior end. Two (A and B) have the columella and margin of outer lip white, but farther inside the aperture is yellowish; the third (C) has the aperture within, the columella and the outer lip margin pinkish-orange. Animals black.

Although externally the shells seem alike (except the coloured aperture in C), their radulae differ in minor details. In general they resemble Peile's fig. 45 of a specimen from Samoa. Peile also recorded a second shell, with similar radula, which had features 'in common with *elata*'.

Specimen A. At least 260 rows, central plate with very strong median cusp, no denticle between it and side cusp, and no denticles or wrinkles externally, lateral plates 4–5 times as long as width of central plate, in ratio of approximately 12 to 10 centrals (cf. Peile, p. 274), base not serrate, apex bifid (fig. 50(*f*)).

Specimen B. About 100 rows, central plate with strong median cusp, no denticle between it and side cusp, externally several wrinkles ending in fine sharp denticles, lateral plates about 3 times as long as width of central plate, in ratio of 2 or 3 to each central, base serrate, apex extremely finely bifid (fig. 50(*e*)).

Specimen C. About 150 rows, central plate with strong median cusp, a tiny denticle between it and side cusp, the side cusp of the right side has also a denticle about midway on its outer margin, externally no wrinkles or denticles, lateral plates about 4 times as long as width of central plate, in ratio of 2 or 3 to each central, base not serrate, apex not bifid (not even on the unused portion of radula) (fig. 50(*d*)).

In radula C it was observed that on the anterior third (*c.* 46 plates) the laterals were directed forwards, on the hinder two-thirds (*c.* 104 plates) backwards. cf. *Cancellaria* (Barnard, 1958. *J. Conch.*, xxiv, p. 243, fig.) (fig. 50(*d*) diagram).

Urosalpinx heptagonalis (Rve.)

Fig. 40(*j*)

1846. Reeve. *Conch. Icon.*, iii, pl. 3, fig. 7 (*Ricinula*), and fig. 53 (*Buccinum contractum*).
1879. Smith. *Proc. Zool. Soc. Lond.*, p. 201, pl. 20, fig. 32 (*innotabilis*).
1884. id. *Zool. H.M.S. Alert*, p. 47.
1903. id. *Proc. Mal. Soc.*, v, p. 376 (*contracta*).
1911. Schepman. *Siboga Exp. monogr.*, xlix, p. 351 (*contracta* var. *innotabilis*).

Protoconch 2 whorls, alt. 0·5, diam. 0·6 mm., smooth. Postnatal whorls 6. Axial ribs on 1st whorl 10–9, on 2nd and 3rd 9, on 4th and 5th 9–8, on 6th 8; crossed by 2 spiral lirae on 1st and following whorls, on 3rd a fine lira between them, increasing to 4 (5) on last whorl, fine spiral lirae also above the upper and below the lower lira; complanate nodules at intersections with ribs; 15 additional lirae on base, of which the 5th (and sometimes also the 8th) is stronger than the others, so that on the body-whorl there are 3 prominent lirae: a peripheral pair, and one (sometimes 2) between these and end of rostrum. Outer lip plicate within (at certain stages of growth). Growth-lines scabrous. 33 × 18 mm.

Operculum oblong-oval, nucleus on outer margin.

Grey, drab, or fawn, the peripheral and the enlarged basal lirae usually darker, or darker brown or bluish-grey where they cross the ribs; often also a darker band below suture; aperture suffused within, brown at the margin; operculum horny.

Radula with 90–100 rows, central plate wide, median cusp large, arising from front margin of base, side cusp smaller, with a denticle between it and median cusp, lateral plate rather slender; hinder rows coloured brown.

Natal (Krauss); Durban (Smith, and S. Afr. Mus.). Morewood Cove (near Umhloti, Natal), 27 fathoms (S. Afr. Mus. P.F. coll.).

Living: off Umhloti River, 27 fathoms; off Tongaat, 36 fathoms (S. Afr. Mus. P.F. coll.). Inyoni Rocks (Amanzimtoti, Natal), and 29° 58′ S. 30° 02′ E., 49 metres (U.C.T.). Delagoa Bay (U.W.). Inhambane (U.C.T.). Mozambique Island (S. Afr. Mus. coll. K.H.B.).

Distribution. Indo-Pacific.

Remarks. The upper whorls are frequently corroded or covered with calcareous algal growth.

There are broad-shouldered and round-shouldered forms.

Smith (1879) remarked that *Murex calcareus* Dnkr. was very close to *innotabilis* and Sowerby returned the P.F. specimen from Tongaat labelled *Tritonidea* [sic] *calcarea* Dnkr.

Rapana bulbosa (Solander)

Fig. 51(*a*)

1859. Chenu. *Man. Conchyl.*, i, fig. 842.
1919. Cooke. *Proc. Mal. Soc.*, xiii, p. 102, fig. 29 (radula).
1942. Gravely. *Bull. Madras Govt. Mus.*, n.s. V, 2, p. 48, fig. 8 *a*.
1952. Satyamurti. ibid., n.s. I, 2, pt. 6, p. 151, pl. 14, figs. 2 *a*, *b*.

Protoconch 2 whorls, alt. and diam. 1 mm., smooth but minutely pitted, ending with a sharp plica. First postnatal whorl with numerous feeble axial ribs, one spiral lira in middle of whorl and another below adjoining suture of next whorl; both lirae become stronger on following whorls, especially the upper one on which 8 or 9 vaulted squamae or hollow tubercles develop; the number of these increases on later whorls, becoming solid tubercles or knobs. 100 (protoconch and 2 whorls missing) × 87 mm. (S. Afr. Mus.).

Radula (Cooke): central plate tricuspid, cusps broad, median one slightly larger than side cusp, which has a denticle on its inner margin, externally several wrinkles.

Durban (Smith, and (living) Cooke).

Off Umhloti River, 27 fathoms, 5 dead but fresh, 10–33 mm. long (S. Afr. Mus. P.F. coll.).

Distribution. Indo-Pacific.

Gen Aspella Mörch

1877. Mörch. *Malak. Bl.*, xxiv, p. 24.
1929. Thiele. *Handbuch*, i, p. 293.

Removed from the *Cymatiidae* and placed by Thiele in the *Muricidae*. Radula formula 1.1.1, central plate tricuspid, a smaller cusp between the median and side cusps, lateral plate unicuspid.

Aspella acuticostata (Turton)

Fig. 51(*b*)

1892. Sowerby. *Mar. Sh. S. Afr.*, p. 9 (*Ranella lamellosa*, non Dnkr.).
1903. Smith. *Proc. Mal. Soc.*, v, p. 378 (*Ranella anceps*, non Lam.).
1915. Bartsch. *Bull. U.S. Nat. Mus.*, 91, p. 95 (*anceps*, non Lam.).
1932. Turton. *Mar. Sh. Pt. Alfred*, p. 109, pl. 24, no. 789 (*Ranella a.*).

Aperture (excl. canal) nearly twice in spire, canal $1\frac{1}{2}$ in aperture. Protoconch $1\frac{1}{2}$ whorls, alt. 0·5, diam. 0·6 mm., smooth, ending with a small plica or

varix extending from suture to suture, followed by a half whorl (perhaps this is postnatal) with 3 plicae or varices the first of which ascends nearly to the top of preceding whorl of protoconch. Postnatal whorls 5; each whorl with 6 varices, of which the 2nd, 3rd, 5th and 6th are stronger than the others, and extend farther over the suture on to the preceding whorl; a cross-section of the shell is a parallelogram, not quite rectangular, with one of the prominent varices at each corner; the strong varices extend across base of body-whorl to rostrum. Growth-lines visible in some places; no spiral sculpture, but there are faint indications of 6 or 7 crenulations on last varix (outer lip). 9 × 4 mm. Creamy-white.

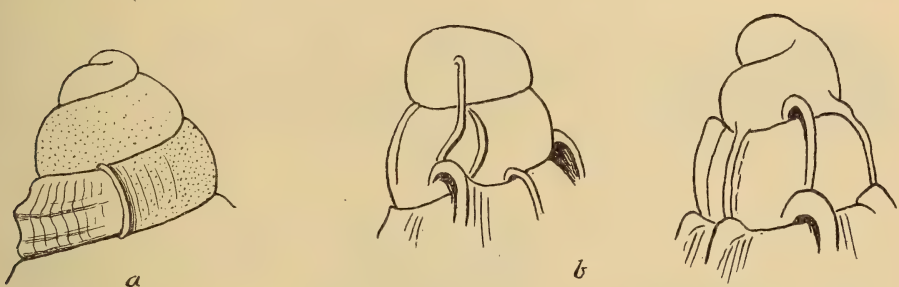


FIG. 51.
Protoconch of (*a*) *Rapana bulbosa* (Sol.).; (*b*) *Aspella acuticostata* Turton.

Port Elizabeth (Sowerby); Port Alfred (Bartsch, Turton); Umkomaas, Natal (Smith); Still Bay (S. Afr. Mus. coll. Muir).

Remarks. The above description is taken from a specimen identified by Tomlin as *A. anceps* Lam. Bartsch said the South African species was different; he gave the type locality for *anceps* as west coast of America (presumably *South* America, because it is not mentioned in Oldroyd, 1927. *Stanford Univ. Publ. Geol.*, II, pt. 2). If Bartsch is correct, Turton's name must be accepted.

The specimen described is only slightly corroded, chiefly on the edges of the varices. It is said to have come from Natal.

The other S. Afr. Mus. specimens, up to 11 (protoconch missing) × 4·5 mm. are all beach-worn. From these the following characters are obtained: aperture (excl. canal) $1\frac{1}{3}$ (juv. with 2 postnatal whorls) to $1\frac{1}{2}$ (3 whorls) to 2 times in spire; canal $1\frac{1}{2}$ times in spire.

Turton gave the size as 15 × 6 mm.

In well-worn specimens the cross-section of the shell is nearly oval with one prominent varix at each end (i.e. nos. 3 and 6), the other prominent varices (2 and 5) being nearly obliterated. At first sight a worn and an unworn shell appear rather different.

S. Afr. Mus. has 2 worn specimens said to have come from Mauritius (Robillard coll.), the larger with 7 whorls (protoconch missing) 20 × 8 mm. Each whorl has 8 ribs or varices, i.e. 3 on each face between the main lateral varices.

Fam. *COLUMBARIIDAE*

1922. Peile. *Proc. Mal. Soc.*, xv, pp. 13, 14, fig. (radula) (near *Muricidae*).
1925. Thiele. *D. Tiefsee Exp.*, xvii, p. 167 (in *Muricidae*).
1928. Tomlin. *Ann. S. Afr. Mus.*, xxv, p. 330 (separate family).

Characterized by the operculum: pear-shaped, tapering rapidly and evenly to an acute nuclear apex, internal surface as in *Fasciolaria*; and by the radula: central plate strongly concave in front, with 3 cusps, the middle one the largest, lateral plate longer than its basal width.

Gen. Columbarium von Martens

Three forms occur at different depths off Cape Point, two of which are regarded as new species. *C. radiale* (Watson) and *angulare* n. sp. are both quite distinct from *rotundum* n. sp.; *radiale* and *angulare* are not so distinct from one another, but their habitats are separated by the area inhabited by *rotundum*.

Columbarium radiale (Watson)

Fig. 52(*a*), (*b*), (*e*)

1882. Watson. *J. Linn. Soc. Lond.*, xvi, p. 382 (*Fusus r.*).
1886. id. *Challenger Rep.*, xv, p. 195, pl. 14, fig. 2 (*Fusus r.*).
1903. Von Martens. *D. Tiefsee Exp.*, vii, p. 29 (*Fusus r.*).

Spiral lirae predominant. Aperture (incl. canal) $1\frac{1}{3}$–$1\frac{1}{2}$ (or even slightly more) times spire. Protoconch $2\frac{1}{2}$ whorls, alt. 2·3, diam. 2 mm. (but more or less corroded), smooth, with indications of axial plicae on last half whorl. Postnatal whorls 7, profile carinately angular. Axial ribs on 1st whorl 10–11, increasing on following whorls to 13, and to 15—20 on last whorl, from suture to suture on 1st and 2nd whorls, but thereafter evanescent above and below the peripheral keel, on which they form bluntly triangular complanate lobes, distinct as far as 6th whorl but feeble and indistinct on 7th; spiral lirae on 1st whorl 3, i.e. one above and one below the prominent peripheral keel, on 2nd and following whorls 2 above and 2 below, on later whorls there may be 2, 3 or 4 lirae above but only 2 (sometimes with a feeble intermediary) below the periphery, and the lower one is often obscured by suture of following whorl; 15–20 additional lirae on base, widely spaced above, closer and less conspicuous on rostrum; close-set growth-lines between the lirae; suture incised, more or less undulate; no parietal callus, columella straight or very slightly curved; canal straight, narrow, distinctly marked off from, and 2–$2\frac{1}{2}$ times as long as rest of aperture, subequal to spire; outer lip not plicate within. Periostracum thin, fibrous, fimbriate. Estimated length of largest specimen (protoconch and tip of canal broken) 74×27 mm.; living examples 55×21 mm., 47×15 mm.

Operculum as described under family, 9×6 mm. in 47 mm. shell.

White, periostracum buff or yellowish-brown, operculum amber-brown.

Radula with 120–130 rows, as described under family (fig. 52(*e*)).

Dead: 35° 4′ S. 18° 37′ E., 150 fathoms (Watson); 34° 33′ S. 18° 21′ E., 318 metres (von Martens).

Living and dead: off Cape Point and west coast of Cape Peninsula, 90–230 fathoms (S. Afr. Mus. P.F. coll.).

Living: 35° 17′ S. 18° 50′ E., 267 metres (s.s. *Africana*).

Remarks. Von Martens (1903) had already suspected this species to be a *Columbarium*, and its appearance is so like a species of this genus that confirmation by the radula was no surprise.

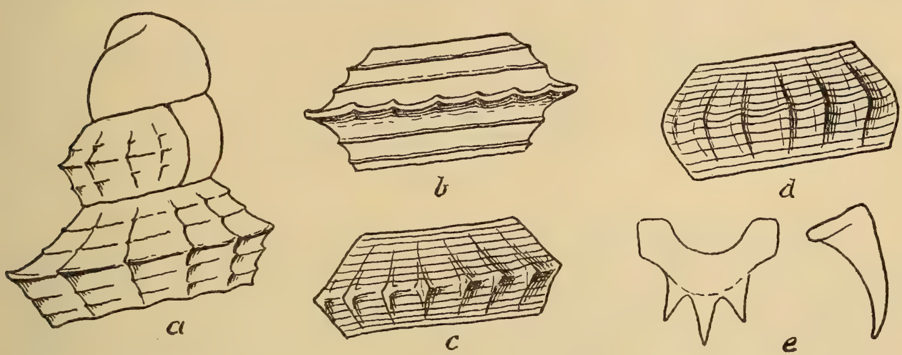


FIG. 52.

(*a*), (*b*) *Columbarium radiale* (Watson), apex and later whorl. (*c*) *C. angulare* n. sp. (*d*) *C. rotundum* n. sp. (*e*) central and lateral radula plates of *C. radiale* (Watson).

Columbarium angulare n. sp.

Fig. 52(*c*)

Axial ribs distinct. Protoconch 2½ whorls, alt. 1·5, diam. 1·3 mm., smooth but a faint median lira on last half whorl. Postnatal whorls 7, profile angulate but not carinate; axial ribs on 1st whorl 10–11, on 2nd 10–12, on 3rd and following whorls 12 (sometimes 13), forming bluntly triangular lobes at intersections with the peripheral lira, from suture to suture on early whorls, but gradually receding from the suture above on later whorls, on body-whorl distinct below periphery as far as level of top of aperture, evanescent on base; spiral lirae distinct but not predominant, the peripheral lira well marked but not carinate as in *radiale*, on 1st whorl 2 above and 2 below peripheral lira, on 2nd 3 above and 2 below, on 3rd 4 above and 2 below, increasing to (7) 8–9 above and 5–6 below, equal in strength but usually 2 of those below periphery stronger than the others; on base at least 15–20 additional lirae with intermediaries. Periostracum thin, fibrous, fimbriate. 51 (protoconch missing) × 13 mm.

Operculum and radula as in *radiale*. The radula with 85–95 rows. Three radulae were examined; in one of them the side cusps on the central plate were

closely approximate to the median cusp, not separated by a V-shaped interval as in the other two (and in the radulae of the other species).

White, periostracum pale buff, operculum amber-brown.

Off Cape Point, 720–900 fathoms, 9 specimens, 4 alive (S. Afr. Mus. A4608 (Type)–A4611. P.F. coll.).

Remarks. A smaller and more slender species than *radiale*: 51 × 13 mm. with 7 postnatal whorls whereas *radiale* has only 6 whorls at a size 55 × 21 mm.

Although the peripheral lira is strong, sometimes almost subcarinate, the lobes at the intersections with the axial ribs are not complanate but 4-sided pyramids, the ribs being more strongly developed than in *radiale*. The spiral lirae above and below the periphery are more numerous.

Occurs in deep water beyond the slope of the continental shelf.

Columbarium rotundum n. sp.

Fig. 52(*d*)

Axial ribs predominant. Protoconch ? (corroded in all specimens). Postnatal whorls 7, profile almost evenly convex with only a slight shoulder in the middle of the whorl and slightly concave above. Apical whorls more or less corroded, axial ribs on 3rd whorl 10, on 4th 10–11, on 5th 11–12, on 6th 12–13, on 7th 13 (14), from suture to suture on 3rd whorl, but gradually receding from suture above on later whorls, on body-whorl distinct below periphery as far as level of top of aperture, evanescent on base; spiral lirae subordinate to the ribs, on 3rd whorl 3 above, one at shoulder, 3 below, increasing on following whorls to 7–8 above and 4–5 (unequal in strength) below; on base at least 15–20 additional lirae with intermediaries. Periostracum thin, fibrous, fimbriate. 75 (protoconch missing) × 25 mm.

Operculum and radula as in *radiale*. The radula with 130–160 rows.

White, periostracum pale buff, operculum amber-brown.

Off Cape Point, 250–760 fathoms, numerous specimens living and dead (S. Afr. Mus. A4592 (Type)–A4607. P.F. coll.).

Remarks. Distinct from *radiale* and *angulare* by the rounded non-angulate profile of whorls, and the predominant axial ribs.

Seems to be subject to much more corrosion than either of the other two species.

Occurs on the outer slope of the continental shelf in deeper water than *radiale*, but not in such deep water as *angulare*.

Columbarium formosissimum Tomlin

1928. Tomlin. *Ann. S. Afr. Mus.*, xxv, p. 331, pl. 25, fig. 1.

Protoconch 2 whorls, bulbous, alt. 1·5, diam. 1·3 mm., smooth, junction with 1st postnatal whorl not sharply marked, the keel on the latter feeble at

the start. Postnatal whorls 7 (incl. the Type, though Tomlin said 8). Peripheral keel on 1st and 2nd whorls not or only feebly undulate, on 3rd with 8 low and somewhat irregular undulations, on 4th with 8 well-marked but slightly irregular undulations, on 5th with 9 lobes, on 6th 10, on 7th 11; the lobes may be blunt or sharply triangular, sometimes hollowed in front. Periostracum thin, fibrous, pale buff.

Radula with *c.* 100 rows.

Cape St. Blaize N. × E. ¼ E., distant 65 miles, 85–90 fathoms; Cape Seal N. × W. ½ W., 55 miles, 87 fathoms; Cape St. Francis NE. 29 miles, 75 fathoms; Glendower Beacon (Port Alfred area) N. ½ W., 16 miles, 66 fathoms, one dead (S. Afr. Mus. P.F. coll.).

Remarks. The *Pieter Faure* obtained 10 specimens. The Type and three others (seen by Tomlin, now in S. Afr. Mus.) have their opercula, but Tomlin made no mention of having extracted and examined a radula. Fortunately there is one other shell containing the animal.

Columbarium natalense Tomlin

1925. Tomlin. loc. cit., p. 331, pl. 25, fig. 2.

Protoconch 2 whorls, smooth, median keel faintly indicated on last half whorl, alt. 1·3, diam. 1·25 mm. Postnatal whorls 6½. Peripheral keel on 1st whorl very feebly undulate, on 2nd 10 feeble undulations, on 3rd 11 distinct lobes, on 4th the lobes beginning to be spiniform, on 5th and 6th whorls 12 more or less hollow spiniform, up-turned lobes.

Cape Natal (Durban) W. ¾ N. distant 12 miles, 85 fathoms (S. Afr. Mus. P.F. coll.).

Remarks. Only one dead specimen was obtained, now in S. Afr. Museum.

The irregularity of the axial threads is due, not to abrasion as Tomlin's description might suggest, but to irregularities of growth; the shell is not at all abraded, though the outer margin of the canal is broken just below the aperture.

As Tomlin remarked, distinctly resembling *canaliculatum* von Martens from the Zanzibar channel, 400 metres.

HYDROZOA FROM SHIPS' HULLS AND EXPERIMENTAL PLATES IN CAPE TOWN DOCKS

by

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(With 3 figures and 1 table in the text)

Introduction

Most of the material described in this paper was collected during a survey of fouling organisms conducted in Table Bay harbour during the years 1946 to 1950, the results of which were published in 1952. During this period some 26 vessels were examined after dry-docking in Cape Town, and several series of experimental plates were exposed for varying lengths of time in the water of the harbour. In recent years a few additions have been made to the collection as opportunity offered.

A study of the fouling community shows that the number of species which settles on a floating structure is small in comparison with that in surrounding waters. Thus, only 14 species of hydroids have occurred in the fouling as against 65 species reported from False Bay near by (Millard 1957). Moreover some species which are common on ships' hulls and in harbour areas are seldom encountered elsewhere (see also discussion). The fouling organisms, in fact, make up a definite community of their own, the individuals of which are particularly suited by their physiological or reproductive abilities to occupy this ecological niche.

One surprising feature about the hydroid community is the fact that some families, such as the Bougainvilliidae, Tubulariidae and Campanulariidae, are well represented, in numbers if not in species, and others, such as the Sertulariidae and the statoplean Plumulariidae, are conspicuous by their absence. The reason for this is not clear. Species which produce free medusae and species with fixed gonophores are both represented and in approximately equal numbers.

Grants from the staff research fund of the University of Cape Town made possible the original work on fouling organisms and the purchase of microscopic apparatus for the subsequent study of the material. The cost of publication was partly defrayed by a grant from the publications fund of the University. Type material has been deposited in the South African Museum, Cape Town (S.A.M.).

List of Species

Tubulariidae	*Tubularia larynx* Ellis & Solander
	Tubularia warreni Ewer
Corynidae	*Sarsia eximia* (Allman)
Bougainvilliidae	*Bougainvillia macloviana* (Lesson)
	Bougainvillia ramosa (van Beneden)
	Rhizorhagium navis n. sp.
Campanulariidae	*Laomedea angulata* (Hincks)
	Laomedea lovéni Allman
	Obelia bicuspidata Clarke
	Obelia dichotoma (Linn.)
	Obelia geniculata (Linn.)
Campanulinidae	*Lovenella chiquitita* Millard
Plumulariidae	*Kirchenpaueria pinnata* (Linn.)
	Plumularia setacea (Ellis & Solander)

Family **Tubulariidae**

Tubularia larynx Ell. & Sol. 1786

Tubularia larynx. Allman 1872, p. 406, pl. 21. Hawes 1955, p. 333, figs. 1–5 (synonymy).

Material. One fruiting colony collected 24/5/47. Record number: SH 188.

Description. Stems branching, reaching a maximum height of 3 cm., annulated at intervals. Coenosarc with 2–4 internal longitudinal ridges of endoderm, which may meet in the centre and divide the interior into canals. The partitions themselves sometimes tubular.

Hydranth with 14–27 proximal and 15–19 distal tentacles. Distal tentacles in a single verticil.

Blastostyles in 1 or 2 rows. Gonophores with 3–4 rounded tentacular processes at distal end, less pronounced in the male than in the female.

Remarks. This species has only once before been reported from South Africa, from the Agulhas Bank by Stechow 1925.

Tubularia warreni Ewer 1953

Tubularia crocea. Millard 1952, p. 420, 428, 440, fig. 3.
T. warreni Ewer 1953, p. 351, figs. 1–4. Millard 1959, p. 299.

Material. 10 colonies from ships' hulls and 1 from experimental plates, most of them very rich, and reaching a maximum height of 7–8 cm. Record numbers: SH 2, 11, 12, 15, 122, 176, 254, 257, 394, 429A, 430A.

Description. Stem with 2–5 (usually 2 or 3) internal longitudinal ridges of endoderm, which when strongly developed may contain tubes. Mature

hydranth with 12–31 tentacles in proximal row, and 13–24 in distal row. Largest hydranths reaching 6 mm. in length from distal tentacles to base of dilation, and 2·5 mm. in basal diameter exclusive of tentacles.

Male gonophores usually without tentacular processes, but very occasionally with 4–5 small conical processes. Female gonophores with 8 flattened tentacular processes, of variable size. Actinula with 6–12 proximal tentacles and up to 6 oral tentacles at liberation.

Nematocysts as described by Ewer.

Remarks. The importance of this species as a fouling organism was discussed by Millard 1952 under the name of *T. crocea.* It is now known that the colonies which occur so abundantly in the dock area are definitely Ewer's species as established by the examination of nematocysts in living specimens. The early material brought in by ships was unfortunately not examined alive, and the undischarged nematocysts of preserved specimens are of no help in identification. No details of structure distinguish the latter from *T. warreni*, and they have thus all been included with this species. Moreover, all the ships concerned had had the opportunity of picking up the species in South Africa at some time during their voyages.

The species is common on the hulls of ships and often forms a thick carpet over the entire surface. It settles throughout the year, but mainly in spring and summer. Ripe gonophores have been observed in all months from January to August, and probably occur in the rest of the year too. Young hydranths may bear gonophores at a height of about 1 cm., and about 35 days after settlement.

As Ewer has suggested a study of the nematocysts in *T. mesembryanthemum* may show it to be synonymous with *T. warreni*, and the former is well known in Europe. It has not been recorded from South Africa.

T. crocea is distinguished from *T. warreni* only by its nematocysts and a few minor features of the anatomy such as the absence of endodermal ridges in the stem. This species has been reported from Lüderitz Bay by Broch 1914, and from a ship in the south Atlantic by Vanhöffen 1910, who suggests that the individuals may have settled in Simonstown (False Bay). It is possible that in both these cases the material was in reality *T. warreni.* (See also discussion.)

Family **Corynidae**

Sarsia eximia (Allman) 1859

Syncoryne eximia. Allman 1872, p. 282, pl. 5. Hincks 1868, p. 50; pl. 9, fig. 2.

Material. 4 samples from ships' hulls, among them one with numerous young medusae, and another with 2 fruiting hydranths. Record numbers; SH 1C, 123, 261B, 305.

Description. Stems tangled and richly branching, reaching a maximum height of about 2 cm. Structure as described by Allman and Hincks. Hydranths

bearing medusa buds at various stages of development, the oldest almost ready for liberation but with the tentacles still unfurled. Medusa buds observed in January.

Nematocysts: stenoteles, varying in size from $8{\cdot}1 \times 5{\cdot}4\ \mu$ to $15{\cdot}3 \times 9{\cdot}9\ \mu$.

Remarks. This is the first sure record of the species from South Africa. Non-fruiting material was reported by Day, Millard and Harrison 1952 from Knysna Estuary as *Syncoryne ?eximia*, and by Millard 1957 from False Bay as *Coryne* sp.

Family **Bougainvilliidae**

Bougainvillia macloviana (Lesson) 1836

Fig. 1, A–C

Perigonimus maclovianus. Vanhöffen 1910, p. 284, fig. 10.
Bougainvillia macloviana. Jäderholm 1923, p. 3. Browne and Kramp 1939, p. 284; pl. 14, fig. 6; pl. 15, fig. 7–14.

Material. Two small colonies, both fruiting. Record numbers: SH 196, 255B.

Description. Hydrorhiza forming a branching network over the surface of barnacle shells and ascidian tests.

Stem unfascicled, slender, unbranched or branching irregularly several times, narrower at base than at summit, reaching a maximum height of 3–4 mm. Perisarc roughly corrugated at base and on origin of branches, smooth or wrinkled for the rest, continued over hydranth as far as the bases of the tentacles as a 'pseudohydrotheca', covered throughout with adherent silt.

Hydranth with 8–12 tentacles in two close alternating verticils. Hypostome conical.

Gonophores arising singly from the stems, branches or hydrorhiza, on pedicels of variable length (usually shorter than gonophore), more or less spherical when mature, completely enclosed in gelatinous perisarc. Oldest medusa with 4 spherical marginal bulbs each bearing 2 black ocelli and 2 tentacles, a conical hypostome with a quadrangular base to its cavity, and 4 unbranched capitate oral tentacles.

Nematocysts of 2 types:

i. Undetermined heteronemes, $6{\cdot}0$–$6{\cdot}5 \times 2{\cdot}0$–$2{\cdot}5\ \mu$.
ii. Desmonemes, $3{\cdot}5$–$4{\cdot}0 \times 2{\cdot}0$–$3{\cdot}0\ \mu$.

Measurements (mm., preserved)	SH 196	SH 255B
Stem, diameter including perisarc	0·05–0·10	0·035–0·12
Pseudohydrotheca, height	0·13–0·23	0·20–0·40
diameter	0·09–0·16	0·12–0·23
Gonophore (without perisarc), height reaching	0·24	0·30
diameter, reaching	0·26	0·36

Remarks. There are certain slight differences between the two colonies, though not sufficient to justify specific separation.

SH 255B is the sparser of the two, and the stem branches at most 2 or 3 times. The hydranths are slightly larger. The oldest medusa is ready for liberation (fig. 1B); it has lost its connexion with the coenosarc of the pedicel and has two of its tentacles unfurled.

SH 196 is a more luxuriant colony and is richly supplied with gonophores, though these are not quite so advanced. Some have 4, and some 8, ocelli and the marginal tentacles are still inturned. Oral tentacles are present in the largest gonophores but could only be recognized in sections. Many empty perisarcal capsules show that a crop of medusae has recently escaped.

The gonophores were observed in May and July.

The only previous record of the species from South Africa is that of Jäderholm 1923.

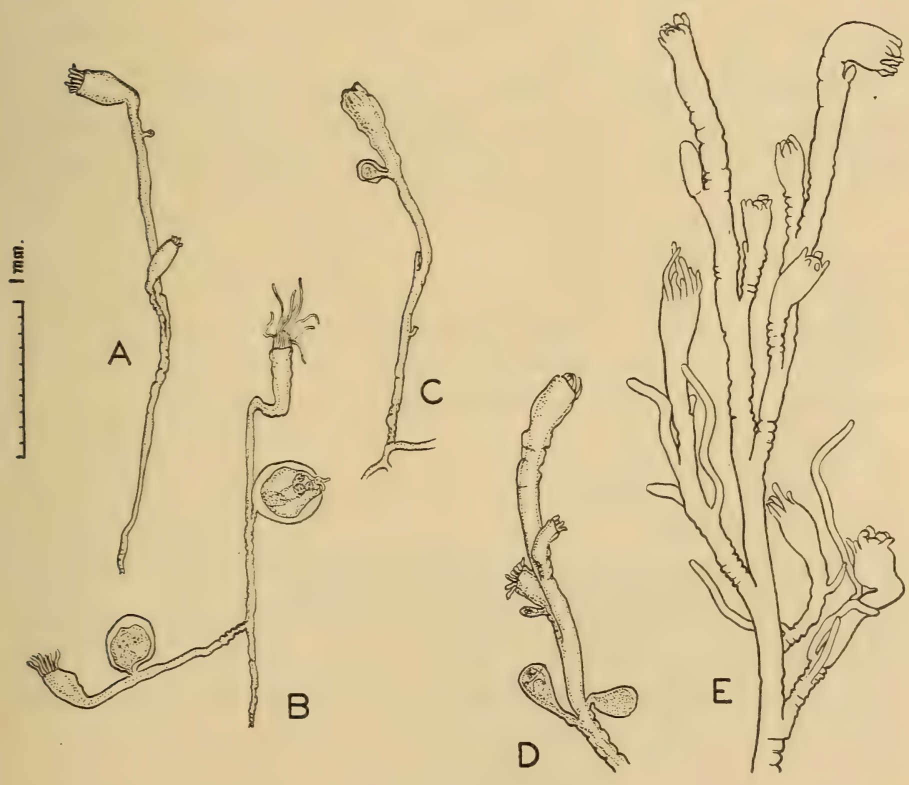

FIG. 1. *Bougainvillia macloviana* (Lesson) (A–C), and *Bougainvillia ramosa* (van Beneden) (D–E). A–C, 3 stems from SH 255B showing gonophores in various stages of development. D–E, two portions of a colony from SH 429D showing filamentous appendages and young gonophores.

Bougainvillia ramosa (van Beneden) 1844

Fig. 1, D–E

Bougainvillia ramosa. Allman 1872, p. 311; pl. 9, figs. 5–7. Russell 1938, p. 152; 1953, p. 153, fig. 74 A–C. Vervoort 1946, p. 135, figs. 52A, 53.
Bougainvillia vanbenedeni. Jäderholm 1909, p. 46; pl. 3, fig. 5.

Material. A bushy, well-preserved colony reaching a maximum height of 1·8 cm. (SH 429D), a single sterile stem of 0·8 mm. (SH 403), and a badly preserved sterile colony with most of the hydranths disintegrated and reaching 1·2 cm. (SH 1A).

Description. Stem unfascicled or weakly fascicled near base, increasing in diameter from base to distal end, irregularly branched, or branches roughly alternate in the distal regions. Perisarc smooth with very occasional groups of corrugations on stem, corrugated or annulated on origins of branches, corrugated partly or wholly on hydranth pedicels, continued over hydranth to base of tentacles as 'pseudohydrotheca'. Filamentous appendages given off profusely from stem, branches or hydranth pedicels, reaching a maximum length of 2·35 mm., occasionally branched.

Medusa buds scarce and present (in February) in the lower regions of the colony only, mostly very young. Marginal bulbs visible, with stumps of 2 tentacles to each. Sections through the oldest stage show the beginnings of 4 oral tentacles.

Nematocysts of two types:

i. Microbasic euryteles, 8·0 × 3·0 μ.

ii. Desmonemes, 4·0 × 2·5 μ.

Measurements (mm., preserved, including perisarc)

Stem, unfascicled part, diameter	0·08–0·20
Hydranth, approximate maximum length	0·66
maximum diameter	0·33
Gonophore, maximum length	0·28
maximum diameter	0·22
pedicel, length	0·07–0·15

Remarks. This material can be assigned to forma *benedeni* Bonnevie 1898, which has been included in *B. ramosa* by most modern workers. It resembles very closely Jäderholm's figure (1909, pl. 3, fig. 5), except that the stem is almost completely smooth.

B. ramosa has been reported from several localities on the south coast by Stechow 1925.

Rhizorhagium navis n. sp.

Fig. 2

Holotype. SH 429B, from the hull of a vessel which had not left Table Bay, collected 10/2/58. (S.A.M. registered number H 124.)

Description. Colony creeping on weeds, other hydroids, etc. Hydrorhiza giving rise to upright stems, each bearing a single terminal hydranth and reaching a maximum height of about 5 mm. Hydrorhiza and stem covered with perisarc, which terminates below the hydranth. Stem usually increasing in diameter from the base upwards. Perisarc irregularly wrinkled or corrugated in parts, particularly near the base, often terminating in a swollen rim.

Hydranth with conical hypostome and 8–16 tentacles arranged in two close, alternating verticils and held alternately elevated and depressed. Mouth widely distensible and occasionally turned completely inside out.

Gonophores in the form of fixed sporosacs, borne on the stem below the hydranth in an irregular fashion with the youngest above and the oldest below, up to 8 per stem, male and female on separate colonies. Gonophore and its pedicel covered with perisarc, which is thick below and very thin in the distal region. Gonophores cryptomedusoid, without tentacle rudiments or radial canals.

Male gonophores ovoid, with terminal opening, bearing the sexual products around a swollen and hollow spadix.

Female gonophores ovoid, tapering below to short pedicel. Spadix swollen and hollow, filling the gonophore in the proximal half, and bearing about 8 eggs, but often more, around the narrowed distal portion. Eggs developing into planulae while still attached to the gonophore.

Nematocysts of 2 kinds:

i. Desmonemes, $3{\cdot}5 \times 2{\cdot}0\ \mu$.

ii. Microbasic euryteles, $6{\cdot}5 \times 3{\cdot}0\ \mu$. Capsule elongated, slightly asymmetrical, aperture off-centre. Butt about $\frac{2}{3}$ length of capsule, thread coiled transversely. Spines on butt not clearly determined.

Colour: creamy white, with pink tinges in the hypostome of the hydranth and spadix of the gonophore.

Development of gonophores. This material was kept alive for two weeks in the laboratory, during which time the development and maturation of the gonophores was observed.

Gonophores of both sexes appear first as spherical hollow buds, covered by ectoderm and endoderm (fig. 2B). Each bud lengthens and becomes pear-shaped, and at the distal end, between ectoderm and endoderm, appears a solid mass of cells, the entocodon (fig. 2C). As the gonophore continues to elongate the proximal part of the endoderm remains closely applied to the ectoderm so that the internal cavity of the spadix is spacious in this region, but the distal part is narrow and separated from the ectoderm by the entocodon which forms a sort of cap over it. The entocodon is now 2-layered, with a shallow subumbrellar cavity between the layers, which is more evident in the female than in the male. The inner layer of the entocodon is thicker than the outer and in it the sex cells accumulate. A thin endodermal lamella is visible

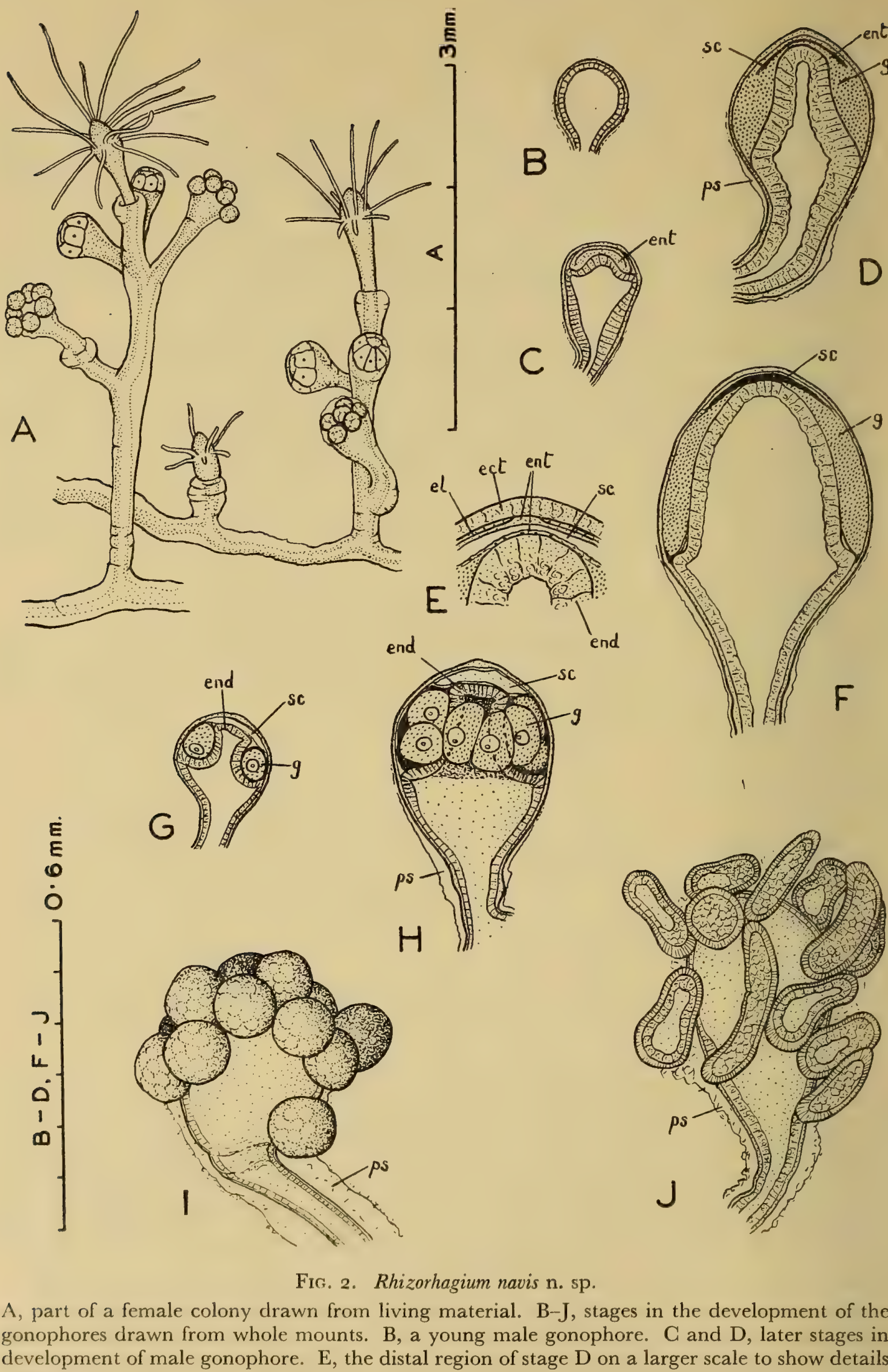

Fig. 2. *Rhizorhagium navis* n. sp.

A, part of a female colony drawn from living material. B–J, stages in the development of the gonophores drawn from whole mounts. B, a young male gonophore. C and D, later stages in development of male gonophore. E, the distal region of stage D on a larger scale to show details of layers. F, a mature male gonophore. G, a young female gonophore. H, a mature female gonophore. I, the female gonophore after the escape of the eggs, and J, with advanced planulae still attached. *ect*, ectoderm. *el,* endoderm lamella. *end,* endoderm. *ent*, entocodon. *g*, germ cells. *ps*, perisarcal covering. *sc.* subumbrella cavity.

between the entocodon and the ectoderm, but there are no radial canals or tentacle rudiments (fig. 2D, E, G).

In the fully formed male gonophore the spermatogenic cells surround the endodermal spadix for about two-thirds of the length, and this distal region is sharply demarcated from the transparent proximal region (fig. 2F).

In the mature female gonophore the distal part of the spadix, surrounded usually by a single tier of eggs, makes up about one-half of the length (fig. 2H). Subsequently, either before or just after fertilization, the eggs escape from the gonophore at the distal end, and with the release of pressure the spadix expands to fill the whole space (fig. 2I). The eggs remain attached to the gonophore by a gelatinous perisarcal envelope and here develop into planulae which reach an advanced stage before they finally escape (fig. 2J).

Measurements (mm., preserved)

Hydrorhiza, diameter	0·08–0·14
Stem, diameter	0·08–0·26
Hydranth, length from perisarc, normal position	0·39–1·29
maximum diameter, normal position	0·19–0·53
Gonophore (without pedicel), male, length, reaching	0·62
diameter, reaching	0·44
Gonophore, female, length, reaching	0·50
diameter, reaching	0·35

Remarks. This material differs from most species of *Rhizorhagium* in that the gonophores are borne on the stem instead of on the hydrorhiza. It resembles most closely *R. robustum* (Warren) 1907 from Natal, but differs in the absence of perisarc over the base of the hydranth, in the presence of more than one gonophore per stem, and in the size and structure of the gonophore itself.

Family **Campanulariidae**

The classification of the Campanulariidae is one of the most vexed questions in hydroid systematics. Among modern workers there are two main schools of thought: that of Broch (1918) who admits only two genera, *Campanularia* and *Laomedea* (excluding *Silicularia*), and who is followed by most continental workers such as Kramp and Vervoort; and that of Stechow (1923c) who recognizes as many as 17 genera.

Broch has distinguished his two genera mainly on the nature of the diaphragm, and has discounted the method of reproduction, whether by fixed sporosacs or medusae. His classification could not be accepted by medusa systematists, and contributes little towards what should be our ultimate object, a single composite classification for hydroids and their medusae.

While recognizing the fundamental importance of diaphragm structure, the author also agrees with Rees (1957) that separate genera should be retained for forms which produce free medusae and forms which produce fixed sporosacs.

The difficulty then arises that various grades of degenerate or imperfectly formed medusae occur in the family, and the grade may even differ in the two sexes. It is proposed therefore for the purpose of classification to consider as 'medusae' only those which are fully formed and which can be classified by the usual medusa keys, and as 'sporosacs' all imperfectly formed grades from the styloid to the eumedusoid types. Thus we can retain *Obelia* for branching forms with a true diaphragm and free medusae, and use *Laomedea* for branching forms with a true diaphragm and fixed gonophores (including *Gonothyraea*, *Hartlaubella* (= *Obelaria*) and *Campalaria*). *Clytia* can be retained for stolonial forms (which may also branch in the form of a drepanium) which produce free medusae. Stechow has shown that the diaphragm in the latter ranges from the 'Campanularia' type to the 'Laomedea' type, and that in this respect the genus is intermediate. The medusa is sufficiently different from that of *Obelia* for generic separation. *Campanularia* can then be retained for forms with an annular thecal thickening in place of a true diaphragm and which produce fixed gonophores. As such it will include *Orthopyxis* with its degenerate medusae.

Laomedea angulata (Hincks) 1861

Laomedea calceolifera. Stechow 1925, p. 438.
L. angulata. Broch 1933, p. 100, fig. 43. Vervoort 1946, p. 305, figs. 134b, 135.
Campanularia calceolifera. Millard 1952, p. 430.

Material. Two rich samples, both including male and female colonies with abundant gonangia (borne in December and February). Maximum height 2·3 cm. Record numbers: SH 327, 423.

Description. Structure and form of the colonies agreeing exactly with previous descriptions. Stem unfascicled, branched or unbranched. No filamentous appendages. Hydrothecae with slightly flaring margins.

Gonangia borne on the bases of the hydrothecal pedicels, usually alternately on the anterior and posterior surfaces. Young ones truncated at distal ends. Female gonangia containing a large number of eggs or fully developed planula larvae. Male gonangia containing gonophores swollen with spermatozoa.

Measurements (mm.)

Stem, diameter	0·10–0·15
Pedicel, diameter	0·08–0·13
Hydrotheca, height	0·37–0·58
diameter at margin	0·24–0·42
height/diameter	1·14–1·71
Gonotheca, female, length	1·00–1·30
diameter	0·39–0·57
Gonotheca, male, length	0·99–1·62
diameter	0·29–0·45

Remarks. See discussion.

Laomedea lovéni Allman 1859

Gonothyraea lovéni. Hincks 1868, p. 181; pl. 25, fig. 2. Allman 1871, p. 55, fig. 28.
G. loveni. Nutting 1915, p. 68; pl. 17, figs. 1–2. Millard 1952, p. 420, 440.
Laomedea loveni. Vervoort 1946, p. 310, fig. 137.

Material. 9 samples; rich colonies reaching a maximum height of 4·0 cm. Record numbers: SH 4, 8, 124, 239, 255A, 261A, 271, 429C, 430B.

Description. Stems slender and branching.

Hydrothecae, and particularly the margins, extremely thin-walled and delicate. Proportions variable, with length from 1½ to over 2½ times the diameter. Marginal teeth with the typical truncated shape, separated by rounded bays. No longitudinal striations.

Hydranth with 19–33 tentacles held alternately elevated and depressed, completely retractable into hydrotheca.

Gonangia abundant, containing up to 8 gonophores, of which as many as 5 may be extruded as meconidia at one time. Female meconidia containing about 5 planulae and bearing about 8 small tentacles. Male meconidia with about 5 tentacles of the same length as the female. Gonangia observed in January, February, and June to September.

Nematocysts of one kind only: basitrichous isorhizas, $6{\cdot}7 \times 2{\cdot}2\ \mu$. Capsule elongated-oval, symmetrical.

Measurements (mm.)

Hydrotheca, length	0·39–0·63
diameter at margin	0·18–0·37
length/diameter	1·59–2·73
Gonotheca, length, reaching	1·28
diameter, reaching	0·36

Remarks. Due to the extreme delicacy of the hydrotheca the measurements may not be wholly reliable, for in mounted specimens the margin is almost invariably damaged, and the side walls tend to fall in, making the whole structure appear narrower than it really is. For the same reason the base of the hydrotheca often becomes telescoped on the pedicel making the diaphragm appear oblique. In perfect, undistorted hydrothecae the length is usually slightly over twice the diameter, and the diaphragm is perpendicular to the hydrothecal axis. In end-on view there are very slight hollows on the outer surfaces of the teeth, but these are far too shallow to give any impression of striations in side view. This is the first record of the species from South Africa.

Obelia bicuspidata Clarke 1875

Laomedea bicuspidata. Vervoort 1946, p. 298, fig. 132; 1946a, p. 344, fig. 10.
Obelia bicuspidata. Millard 1958, p. 174.

Material. A small colony, reaching a maximum height of 6 mm., from a floating dock from Calcutta. Collected 20/2/48. Record number: SH 341.

Description. Stem unfascicled, unbranched or sparingly branched.

Hydrothecae rather small for the species and unstriated. The bicuspid nature of the marginal teeth is not evident at first sight, for the bays between members of a pair are practically equal in size to those between consecutive pairs, but an end-on view of a hydrotheca shows the typical polyhedral outline, with two internal keeled teeth arising from each plane.

Gonothecae present, but scarce.

Measurements (mm.)

Hydrotheca, length	0·34–0·42
diameter	0·18–0·22
length/diameter	1·59–1·89
Gonotheca, length	0·52–0·62
diameter	0·17–0·21

Remarks. This species has undoubtedly been transported from India, whence it has been reported by Annandale 1915 as *O. spinulosa.*

Obelia dichotoma (Linn.) 1758

Obelia dichotoma. Millard 1952, p. 420, 426, 433, fig. 3; 1957, p. 198; 1958, p. 174.

Material. Numerous samples, some very rich, from ships' hulls and experimental plates. Maximum height 4·5 cm. Record numbers: SH 6, 7, 160, 220, 228, ?256, 279, 340, 349, 395, 398, 409, 410.

Remarks. This species has been discussed in a paper on fouling organisms (Millard 1952). It settles mainly in the autumn, yet gonophores have been observed in February, March, May to July, and September.

Obelia geniculata (Linn.) 1758

Obelia geniculata. Hincks 1868, p. 149; pl. 25, fig. 1. Millard 1952, p. 420, 433; 1957, p. 198.

Material. Two samples from experimental plates, reaching a maximum height of 1·0 cm. Gonophores observed in March and June. Record numbers: SH 347, 353.

Family **Campanulinidae**

Lovenella chiquitita Millard 1957

Fig. 3

Lovenella chiquitita Millard 1957, p. 198, fig. 7.

Material. A fairly rich colony growing on barnacle shells and other hydroids. Record number: SH 430C (28/7/58).

Description. Pedicels arising directly from hydrorhiza or branching in a sympodial manner as often as nine times. Colony reaching a maximum height of 1·89 mm. Details of structure exactly as in original description.

Gonothecae plentiful, most of them empty, but two in the process of discharging medusae (here described for the first time).

Medusa at time of liberation without apical process or peduncle, with 8 unbranched marginal tentacles of which the perradial ones are longer than the interradial, without marginal or lateral cirri, with 8 closed adradial marginal vesicles each containing two concretions, with a short stomach and a simple quadrangular mouth, with narrow radial and circular canals, without gonads, measuring approximately 0·3 mm. in depth and 0·4 mm. in diameter.

Colour: living hydranths colourless. Medusa transparent, with brown patches on the bases of the tentacles and in the stomach.

Measurements. The measurements are completely within range of those quoted for the holotype and paratypes (Millard 1957), except for the gonothecae, some of which are slightly larger, the maximum size recorded being 0·70 mm. in length by 0·32 mm. in maximum diameter.

Remarks. Living material of this species was kept alive for a few days in the laboratory. One medusa was in the process of escaping from its gonotheca

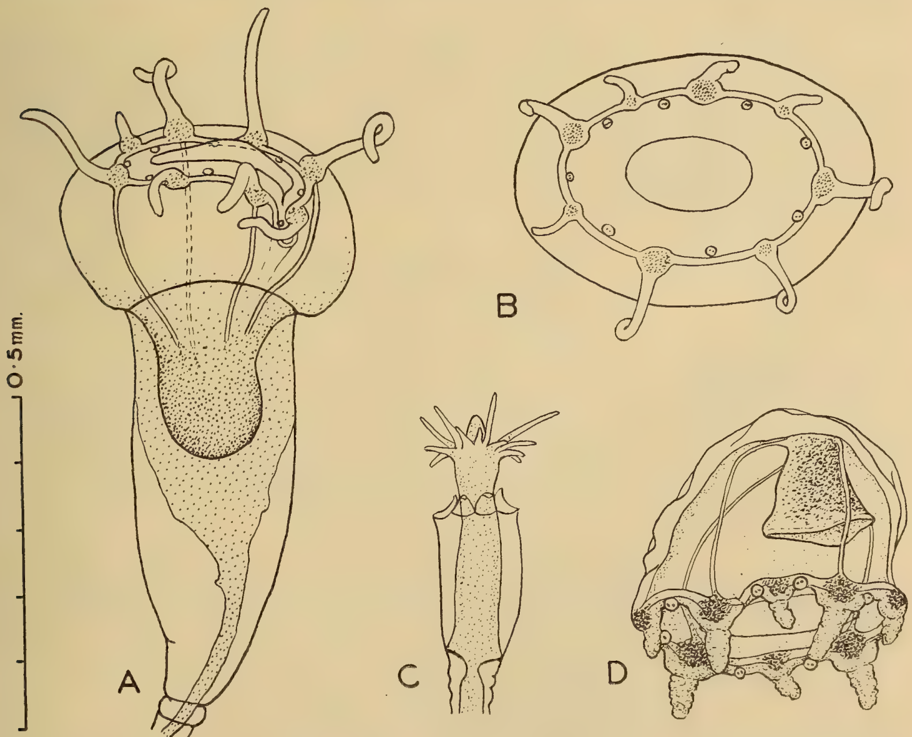

FIG. 3. *Lovenella chiquitita* Millard.

A–C from living material, and D from preserved material slightly shrunk. A, the young medusa escaping from the gonotheca, B, ventral view of newly liberated medusa. C, the hydranth, partially extended. D, lateral view of newly liberated medusa.

at the time of collection, but died 2 days later without becoming completely free. A second medusa successfully escaped 3 days after collection and was fixed and mounted.

The medusa, in the absence of lateral cirri, appears to belong to the genus *Phialella* as defined by Rees 1939 and Russell 1953, rather than *Lovenella*. These two genera, although closely related, are clearly distinguished by the presence or absence of lateral cirri in the medusa, and by the nature of the operculum in the hydroid, and are in fact usually placed in separate sub-families. We are now confronted by a species in which the hydroid generation belongs to one of these genera and the medusa to the other.

Kramp (1932a and earlier papers quoted therein) stresses the value of the hydroid operculum in distinguishing sub-families of Campanulinidae, *Lovenella* being included in the Calicellinae, and *Phialella* presumably in the Campanulininae, although the development of the operculum was described in only one species of the latter, namely *Campanulina lacerata* (Johnston). The important point is that the difference in the operculum in the two sub-families is the result of a fundamental difference in development and should therefore be of good systematic value.

In the present species the operculum clearly belongs to the 'Lovenella' type, and the only feature excluding it from this genus is the absence of lateral cirri in the newly liberated medusa. Since it is possible that lateral cirri may develop at a later stage it is proposed to retain the species in *Lovenella*, at least until such time as the mature medusa is known and the development of the operculum in *Phialella* is fully understood.

Family **Plumulariidae**

Kirchenpaueria pinnata (Linn.) 1758

Kirchenpaueria pinnata. Millard 1952, p. 420, 426, 433, fig. 3; 1957, p. 233.

Material. Abundant colonies from a variety of vessels and experimental plates. Maximum height of colony 4·1 cm. Record numbers: SH 13, 14, 77, 145, 209, 245, 270, 272, 280, 282, 285, 288, 291, 292, 304, 313, 326, 358, 359, 361, 365, 368, 430D.

Remarks. This species was discussed in a paper on fouling organisms (Millard 1952). Gonophores have been observed in January, February, July and October. Settling has been observed in most months of the year but mainly in spring.

Plumularia setacea (Ell. & Sol.) 1755

Plumularia setacea. Hincks 1868, p. 296; pl. 66, fig. 1. Millard 1952, p. 420; 1957, p. 232; 1958, p. 212.

Material. Two small sterile colonies, with a maximum height of 0·7 cm. Both colonies fall within forma *typica* Broch 1914. Record numbers SH 1B, 200.

Discussion

In all, 14 species of hydroids have been reported from floating structures in Table Bay harbour, and an attempt was made to determine the origin of the species, whether local or foreign (Table 1). Theoretically a history of the vessels concerned (which had been fully recorded) should provide the answer, but in actual fact it was no easy matter. Many of the vessels had had long voyages with varied ports of call, often visiting Cape Town before their final dry-docking, and sometimes lying idle in port for weeks or even months. Such vessels might carry a mixture of foreign and local forms. Only one vessel (a floating-dock towed from Calcutta) could be said to carry exclusively foreign material, for she was dry-docked two days after arrival and had no time to accumulate local forms. On the other hand one must bear in mind that foreign species might be brought into the docks and reproduce there and even establish themselves, eventually settling on vessels which have never left the area.

	Experimental plates (local)	*Purely local vessels*	*Purely foreign vessels*	*Local+ foreign vessels*	*Total*	*Distribution*
Kirchenpaueria pinnata	17	5	–	1	23	cosmopolitan
Obelia dichotoma	6	4	1	2	13	cosmopolitan
Tubularia warreni	1	5	–	5	11	endemic to S. Africa
Laomedea lovéni	2	4	–	3	9	north Atlantic
Sarsia eximia	–	3	–	1	4	cosmopolitan
Bougainvillia ramosa	1	2	–	–	3	cosmopolitan
Plumularia setacea	1	1	–	–	2	cosmopolitan
Obelia geniculata	2	–	–	–	2	cosmopolitan
Bougainvillia macloviana	–	2	–	–	2	Antarctic
Laomedea angulata	–	2	–	–	2	north Atlantic and Falklands
Obelia bicuspidata	–	–	1	–	1	cosmopolitan
Tubularia larynx	–	1	–	–	1	cosmopolitan
Lovenella chiquitita	–	1	–	–	1	endemic to S. Africa
Rhizorhagium navis	–	1	–	–	1	endemic to S. Africa

Table 1. A list of the hydroid species in order of abundance, giving the number of records from various sources. 'Local' vessels include those whose itinerary was restricted to the South African coast.

Of the species listed, three, namely *Tubularia warreni*, *Lovenella chiquitita* and the new species *Rhizorhagium navis*, are endemic to the country and could only have a local origin. Yet the identity of *T. warreni* is by no means finally settled. The very fact that the species is characteristic of ships' hulls and harbour areas leads one to suspect that it is transported from place to place, and possibly from Europe to South Africa, by ships, and to doubt whether it should be held specifically distinct from such species as *T. mesembyranthemum* and *T. crocea* which are abundant in harbours elsewhere. Only a full knowledge of the variation of nematocysts in all related species can settle the problem.

Of the remaining species all, with the exception of *Obelia bicuspidata*, have been found on experimental plates or on vessels with a South African itinerary; some of the latter had never left Table Bay. *Kirchenpaueria pinnata*, *Obelia dichotoma*, *Plumularia setacea* and *Obelia geniculata* in addition are common round the South African coast, and can safely be assumed to have had a local origin. *Sarsia eximia*, *Bougainvillia ramosa* and *Tubularia larynx* are by no means common, but have all been recorded from the country on previous occasions.

Bougainvillia macloviana is an Antarctic form known to occur on ships' hulls (Vanhöffen 1910). It can apparently penetrate as far north as South Africa for it has been reported from off Borrocouto by Jäderholm 1923.

The records of *Laomedea angulata* and *L. lovéni* are interesting and suggestive, for both are north Atlantic species and, apart from one record of *L. angulata* from Simon's Bay (Stechow 1925) and one from the Falklands (Ritchie 1907a), they have apparently not been reported before from the Southern hemisphere. They appear to be recent colonizers of the harbour area, almost certainly transported there by ships from Europe or the Mediterranean. Although well established, for they settle readily on newly exposed areas, they have not spread to other parts of the coast. Stechow's record of *L. angulata* from Simon's Bay was possibly also an immigrant from northern waters.

Only two species are of exclusively foreign origin, and were found on the hull of the floating-dock from Calcutta mentioned above. These were *Obelia bicuspidata* and *O. dichotoma*. Both are cosmopolitan in distribution and both are also known from South Africa. *O. dichotoma* also occurs abundantly on local vessels and experimental plates. These records provide supporting evidence that species can be transported over long distances without serious inconvenience, and that the genus *Obelia* is particularly hardy in this respect, for the material was alive and reproducing freely on arrival.

In conclusion it is noteworthy that more than half (8 out of 14) of the species recorded here are cosmopolitan in distribution, and 3 at least are on the way to becoming so. One might pose the question: is their presence on ships' hulls a result of their world-wide abundance and ability to live under varied conditions, or is their wide distribution a result of transportation by ships?

Summary

A total of 14 species of hydroids is recorded. Amongst them is one new species, *Rhizorhagium navis*, and one new record for the country, *Laomedea lovéni* Allman. The medusa of *Lovenella chiquitita* Millard is described for the first time. The composition of the hydroid fouling fauna is discussed and suggestions made as to the origin of the species.

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Addendum

The registered numbers of Hydroid type material previously described by N. A. H. Millard and deposited in the South African Museum collections have not been published and are added below. Numbers in parenthesis are University of Cape Town station numbers or serial numbers of the collection made by the S.S. *Pieter Faure* (PF).

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Hydractinia altispina. Cotypes: S.A.M. H87 (F274), S.A.M. H88 (CP258), S.A.M. H89 (B92).
Hydractinia kaffraria. Cotypes: S.A.M. H90 (BRE111A), S.A.M. H91 (HAM3Q). Paratype: S.A.M. H92 (SUN3N).
Zygophylax cornucopia. Holotype: S.A.M. H93 (FB131B). Paratypes: S.A.M. H94 (TB1B), S.A.M. H95 (FAL78S), S.A.M. H96 (FAL217N).

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Hydractinia canalifera. Holotype: S.A.M. H97 (CP332).
Eudendrium deciduum. Holotype: S.A.M. H98 (FAL52V).
Halecium parvulum Bale, var. *magnum*. Holotype: S.A.M. H99 (FAL274R). Paratypes: S.A.M. H100 (FAL159L), S.A.M. H11 (PF405A), S.A.M. H30 (PF16287A).
Campanularia morgansi. Holotype: S.A.M. H24 (PF15675B). Paratypes: S.A.M. H7 (PF351C), S.A.M. H101 (FB119L), S.A.M. H102 (FAL26L), S.A.M. H32 (PF18232B).
Lovenella chiquitita. Holotype: S.A.M. H103 (FAL288J). Paratypes: S.A.M. H104 (FB131F), S.A.M. H105 (FAL108.O).
Hebella furax. Holotype: S.A.M. H34 (PF18293B). Paratype: S.A.M. H106 (FAL58Y).
Synthecium hians. Holotype: S.A.M. H107 (FAL214G).
Sertularella capensis. Holotype: S.A.M. H108 (FB114A). Paratypes: S.A.M. H109 (FB115D), S.A.M. H110 (FAL64L).
Sertularella falsa. Holotype: S.A.M. H111 (FB119C). Paratypes: S.A.M. H112 (FB131H), S.A.M. H113 (CP333B).

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Clytia serrata. Holotype: S.A.M. H115 (MOR216C).
Zygophylax geminocarpa. Holotype: S.A.M. H59 (PF12308A).
Zygophylax infundibulum. Holotype: S.A.M. H36 (PF10781B).
Hincksella corrugata. Holotype: S.A.M. H85 (PF12456J).
Sertularella dubia Billard var. *magna*. Holotype: S.A.M. H54 (PF12028B).
Sertularella mediterranea Hartlaub var. *asymmetrica*. Holotype: S.A.M. H116 (IN49K).
Sertularia linealis Warren var. *longa*. Holotype: S.A.M. H117 (IN140E).
Kirchenpaueria adhaerens. Holotype: S.A.M. H118 (RHB52G).
Monostaechas natalensis. Holotype: S.A.M. H79 (PF12456C). Paratypes: S.A.M. H48 (PF11803AF), S.A.M. H76 (PF12392G).
Monostaechas faurei. Holotype: S.A.M. H58 (PF12028F).
Plumularia irregularis. Holotype: S.A.M. H119 (DBN70Q).
Halicornaria africana. Holotype: S.A.M. H120 (AFR1028B).
Halicornaria arcuata (Lamx.), var. *epizootica*. Holotype: S.A.M. H73 (PF12392D).
Thecocarpus giardi Billard, var. *solidus*. Holotype: S.A.M. H121 (AFR1028A).

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XXVII.	1929	Anthropology		1	10	0
XXVIII.	1929–1932	Palaeontology		2	12	3
XXIX.	1929–1931	Zoology		2	8	0
XXX.	1931–1935	Zoology		3	13	10
INDEX	of papers, authors, and subjects, published in Vols. I-XXX			0	1	6
XXXI.	1934–1950	Palaeontology	(Part 4 only)	0	14	0
XXXII.	1935–1940	Zoology		3	3	7
XXXIII.	1939	Zoology		2	2	0
XXXIV.	1938	Zoology		2	8	0
XXXV.	1956	Zoology		6	0	0
XXXVI.	1942–1948	Zoology		2	11	0
XXXVII.	1947–1952	Archaeology		1	16	0
XXXVIII.	1950	Zoology		3	15	0
XXXIX.	1952	Zoology		2	14	6
XL.	1952–1956	Botany		1	6	6
XLI.	1952–1955	Zoology		4	0	0
XLII.	1953–1956	Palaeontology		3	7	6
XLIII.	1955–1957	Zoology and Palaeontology		2	0	0
XLIV.	1957–1959	Zoology and Palaeontology		2	15	0

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ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XLV

PART II, *containing*:—

Additions to the South African Museum Collection of Marine Fishes. By F. H. Talbot, M.Sc.

Note on Locality Records of Freshwater Fishes presented by F. D. McKean to the South African Museum. By R. A. Jubb.

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ADDITIONS TO THE SOUTH AFRICAN MUSEUM COLLECTIONS OF MARINE FISHES

By

F. H. Talbot, M.Sc.

Barbourisia rufa Parr*

Parr, A. E., Barbourisidae, a new family of deep-sea fishes, *Copeia*, 1945, 127–129, 1 pl.

Two specimens, the locality of one 'off Table Bay 1956', no depth given, and the other 32°10'S./16°15'E., 285 fathoms, 1959. (Registered numbers S.A.M.19967 and S.A.M.22893 respectively.)

As the only record in literature of *Barbourisia rufa* is a single specimen taken from the Gulf of Mexico in 1937, these two examples from the South Atlantic off Cape Town are a most interesting find and greatly extend the distribution of this species. The present two specimens differ slightly from the 180 mm. holotype, the main differences being: slightly smaller orbit, slightly shorter jaws, and shorter gill rakers. In all other measurements and characteristics they show very close similarity (see Table 1) except that in Parr's description of the genus he states '7 soft branchiostegal rays', and the present specimens have eight. As the thick skin covering the rays and their soft nature make counting difficult it is probable that this will prove to be a miscount.

A pseudobranch of a few gill tufts is present. Lateral line pores between 6 and 16 shows the occasional raised pores mentioned by Parr. All pores are small and without flaps, excepting the last which is very large, being the full width of the lateral line tube.

Post-mortem colour is a brilliant scarlet-red (Ridgeway), which fades rapidly on preservation to an off-white.

Pterothrissus belloci Cadenat

Cadenat, J. 1938. Note sur deux poissons nouveaux de la côte occidentale d'Afrique. *Bull. Mus. Hist. nat., Paris* (2), **10**, 361–369, 2 pl.

Poll, M. 1953. Poissons. III. Téléostéens Malacoptérygiens. *Résult. sci. Expéd. océanogr. belge Eaux côt. afr. Atlant. S.*, 4 (2), 1–258.

Four specimens trawled off Walvis Bay, 22°2'S./13°26'E., in 80 fathoms (registered number S.A.M.21706). Donated by the Director, Division of Fisheries, Department of Commerce and Industries.

Poll (1953) has found this species to be abundant on the deeper portions of the continental shelf off tropical West Africa. The present specimens are the most southerly record.

*Since the above was written R. R. Rofen, *Galathea Rep.*, **1**, pp. 255–260, September 1959, records and plates a specimen of *B. rufa*, from near Madagascar, mid-water, 450-700 metres. This extends the range of the family to the Indian Ocean.

	Type	S.A.M. 19967	S.A.M. 22893
Standard length	180 mm.	297 mm.	294 mm.
Head	35·6	31	32
Snout	11·7	11·1	11·6
Orbit diameter	4	2·7	2·7
Upper jaw length	25·6	22	23
Low jaw length	28	21	21
Greatest width of skull	15	12·8	15
Interorbital distance	12·5	10·4	11·9
Snout to D. origin	64	61	61
Snout to A. origin	69	68	71
Snout to V. origin	54–55	50	50
Dorsal fin base	24	26	25
Anal fin base	18	17·5	16·3
Width of V. base	1·3–1·5	1·3	1·7
Width of pectoral base	2·2	1·7	2·4
Length of pectoral rays	6·5–7	7·4	6·1
Length of ventral rays	6–6·5	6·4	5·1
Longest dorsal ray	11	8·4	8·2
Longest anal ray	10·5	8·4	9·5
Depth at shoulder girdle	25	20	23
Least depth caudal peduncle	5	8·1	8·2
D. to procumbent caudal rays	8	7·7	8·2
D. to mid-base of caudal rays	14·5	14·1	15·3
Longest gill rakers	4·2	2·4	2·7
Dorsal count	20	20	20
Anal count	16	17	16
Number of lateral line pores	29	29	30
Branchiostegal rays	7(?)	8	8
Gill rakers	6 + 14	6 + 15	6 + 15

TABLE I. A comparison of proportions of the type of *Barbourisia rufa* (from Parr, 1945) with two South African specimens. Lengths are expressed as a percentage of standard length.

Allothunnus fallai Serventy

Serventy, D. L. 1948. *Allothunnus fallai*, a new genus and species of tuna from New Zealand. *Rec. Canterbury (N.Z.) Mus.*, **5**, 131–135.

One specimen, fork length 835 mm. taken by spear gun in 3 fathoms off Millers Point, Cape Peninsula, on 8 April 1958, and donated by Mr. D. Hammond (registered number S.A.M.21546).

The Slender Tunny, with its reduced dentition and high gill-raker count, is stated by R. A. Falla (in a note appended to Parrot, 1958, *Rec. Dom. Mus., Wellington* **3**, p. 119) to be 'not uncommon in southern New Zealand seas, but rarely caught'. Serventy's original 3 specimens were from South Island, New Zealand, south of 43°, and Falla mentions sight and photographic records from the Auckland Islands (50° S.), so it can presumably be considered a cold-water tunny. This is the first South African record.

The present specimen shows some small differences from the original description (see Table II), but there seems no doubt that it is conspecific.

Scaling is not as complete as in the type. Behind the distinct corselet of larger scales the body is covered in fine scales on its upper half to below the lateral line and the lower half of the sides and the belly are naked. The vomer and palatines are slightly rough to the touch, being covered in microscopic granular teeth. Serventy doubtfully gives a vertebral count of 41. X-ray photographs of the present specimen show 39 vertebrae however.

Fin counts: Dorsal XVII 12 plus 7; anal 13 plus 7. Gillrakers 23 plus 48 left, and 22 plus 53 right.

The specimen is a mature male.

Post-mortem colour was steely blue above shading to silver below, and with no distinctive markings. A photograph taken immediately after death shows a dark line from the pectoral tip, running longitudinally and upwards to the 3rd dorsal finlet.

	Type	S.A.
Fork Length (snout to caudal fork)	616 mm.	850 mm.
Diameter of eye	3·7	3·6
Head Length	26	26
Snout to origin of pectoral	27	28
Snout to origin of first dorsal	31	30
Snout to origin of second dorsal	63	59
Snout to origin of ventral	28	31
Snout to vent	64	61
Depth of body at origin of first D. (= approx. greatest depth)	21	20
Depth of body at vent	18·8	17·4
Length of pectoral	10·5	11·2
Length of pectoral alongside body	12·2	12·2
Inter-orbital distance	7·8	7·2
Length of maxillary	9·3	9·3
Snout to hinder edge of pre-opercle	20·1	19·8
Height of first dorsal	10·4	8·1
Height of second dorsal	7·9	7·5
Height of anal	7·8	7·8
Snout to anterior nostril	4·6	4·9
Snout to posterior nostril	6·8	6·9
Longest gill raker	4·5	4·2

TABLE II. A comparison of the proportions of the type of *Allothunnus fallai* with the South African specimen. Fork length is in mm. and all other measurements are expressed as a percentage of fork length.

NOTE ON LOCALITY RECORDS OF FRESHWATER FISHES PRESENTED BY F. D. McKEAN TO THE SOUTH AFRICAN MUSEUM

By

R. A. Jubb

Department of Ichthyology, Rhodes University, Grahamstown

Gilchrist and Thompson (1917) have recorded species of fishes presented by Mr. F. D. McKean and have given the locality as Sawmills, Bulawayo, Rhodesia. Sawmills is actually a railway station approximately 60 miles north of Bulawayo, on the Bulawayo-Victoria Falls railway line, and situated on the Umgusa River. The Umgusa is a tributary of the Gwaai River which belongs to the Middle Zambezi River system. The fish fauna of the Upper Zambezi system above the Victoria Falls differs from that of the Middle Zambezi system (Jubb, 1958, p. 178). Except for *Tilapia melanopleura*, which is widely distributed, the species represented in McKean's collection are found only in the Upper Zambezi system and the Kafue River, and not in the Middle Zambezi River system; as a typical example the predatory *Serranochromis*, much sought after by anglers, are conspicuous by their absence from this section of the Zambezi River. It would appear that Mr. McKean's address, prior to 1917, has been recorded as the locality from which the specimens were collected. It has not been possible to get any information about Mr. McKean.

The names listed are in accordance with Barnard's (1949) revision of the South African Cichlidae. I have personally examined the *Serranochromis* specimens in the South African Museum which were presented by Mr. McKean. It is highly probable that these fishes actually were collected in the Zambezi above the Victoria Falls.

p. 548 *Ctenopoma multispinis* Peters.
p. 538 Recorded as *Pelmatochromis robustus*, but is *Haplochromis smithii* Castelnau.
p. 526 Three specimens recorded as *Serranochromis thumbergi* Castelnau.
p. 525 Two specimens recorded as *Serranochromis angusticeps* Boulenger.
p. 499 One specimen *Tilapia mackeani* Gilchrist & Thompson, 1917, which is a synonym of *Tilapia melanopleura* Dumeril.
p. 482 Two specimens *Tilapia intermedia* Gilchrist & Thompson, 1917, which are synonyms of *Tilapia macrochir* Boulenger.
p. 481 *Tilapia kafuensis* Boulenger.

Barnard, K. H. 1949. Revision of South African Cichlidae. *Rep. Inland Fish. Dept., C.G.H.*, No. 5 (1948), 48–61.

Gilchrist, J. D. F. & Thompson, W. W. 1917. The freshwater fishes of South Africa. *Ann. S. Afr. Mus.*, **11**, 465–575.

Jubb, R. A. 1958. A preliminary report on the collections of freshwater fishes made by the Bernard Carp expeditions to the Caprivi Strip, 1949, the lower Sabi River, 1950, and to Barotseland, 1952. *Occ. Pap. nat. Mus. S. Rhod.*, No. **22B**, 177–189.

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The Polychaet Fauna of South Africa. Part 5. *Errant Species dredged off Cape Coasts.* By J. H. DAY. (With 14 figures in the text.)

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THE POLYCHAET FAUNA OF SOUTH AFRICA

PART 5. ERRANT SPECIES DREDGED OFF CAPE COASTS

by

J. H. Day

Professor of Zoology, University of Cape Town

Contents

Introduction

Earlier papers in this series have dealt with the estuaries and intertidal fauna of Moçambique, Natal and Cape Coasts. This is the first account of species which occur below tide-marks and it will be evident from the long lists of collecting stations that a great deal of field-work has been done since the work first started in 1947. Actually the prime object of this dredging survey is to determine distribution patterns around the southern part of Africa and not only the Polychaeta but the whole benthonic fauna is being surveyed. Many systematic reports on the other groups have been published and further work is in progress. All the records are being entered on card catalogues and when the area has been adequately covered a biogeographic analysis will be attempted. Meanwhile many new species are being discovered.

The material has been obtained from many sources. I am indebted to the Director of the Division of Fisheries for dredgings brought in by R.S. *Africana II* and *Palinurus* and I also wish to thank Messrs. Irvin and Johnson for allowing students to collect specimens on board commercial trawlers. The Hydrographic Section of the South African Navy generously provided facilities for dredging on board S.A.S. *Natal* during three cruises between Port Elizabeth and Durban and Dr. Nafe of the Lamont Geological Observatory kindly allowed me facilities during the cruise of the *Vema* between Cape Town and Durban. To all of these organizations I tender my thanks but the bulk of the material has been collected by members of my own department working on small boats during university vacations. In this way rich hauls were made in Lamberts Bay, Saldanha Bay, Table Bay, False Bay, Mossel Bay and Algoa Bay. The expenses of such trips were covered partly by grants from the Staff Research Fund of the University and partly by grants from the South African Council of Scientific and Industrial Research. The latter organization has also paid the

salary of my research assistant for many years and Dr. John Croil Morgans made some very valuable collections by diving in False Bay during his tenure of the post. A full report of his diving survey has recently been published elsewhere (Morgans 1959).

Earlier records of errant polychaets dredged off the Cape coasts will be found in McIntosh (1885 and 1904), Ehlers (1908 and 1913), Ramsay (1914), McIntosh (1925), Monro (1930 and 1936), Day (1934) and Treadwell (1943). The species recorded by Augener (1918 and 1931) from dredgings off South West Africa must be included for there can be no doubt that this area has a similar fauna to the Western Cape.

Altogether these earlier workers recorded 74 species of errant polychaets from below tide-marks. The present paper contains new records, notes or full descriptions of 171 species. 61 of them are species known from the earlier dredgings, 42 are species previously known only from the shore, 34 species are new records for South Africa, 22 are new species and 12 are doubtful species or new varieties. The full total of species now known from dredgings around the Cape or South West Africa is 184 and for the sake of convenience, the 13 species recorded by earlier workers and not included in the systematic section of this paper is given below.

Aphroditidae

Eunoe assimilis McI.—McIntosh 1925
Eunoe macrophthalma Mc.I.—McIntosh 1925
Lagisca hubrechti McI.—Monro 1930
Macellicephala mirabilis McI.—McIntosh 1905, 1925
Polynoe caput-leonis McI.—McIntosh 1925
Panthalis oerstedi var. *capensis* McI.—McIntosh 1925
Leanira hystricis Ehl.—McIntosh 1925

Hesionidae

Magalia (=*Syllidia*) *capensis* (McI.)—McIntosh 1925
?*Irmula spissipes* Ehl.—Augener 1918

Syllidae

Sphaerosyllis perspicax Ehl.—Augener 1918

Nereidae

Nereis pelagica Linn.—Ramsay 1914

Eunicidae

Eunice grubei Grav.—Ehlers 1908a
Onuphis quadricuspis Sars—McIntosh 1925

The other names which occur in the literature are synonyms of species described in this paper. Many of them are misidentifications of European species and one of my main tasks has been to eliminate these names from the South African faunistic lists. Unfortunately the descriptions are often incomplete and it has been necessary to examine the original material. During 1952 the C.S.I.R. provided me with funds to visit the British Museum and examine the South African material housed there and to compare my own collections with the types.

I wish to thank the Director of the British Museum and Mr. Norman Tebble of the Annelid Section for their kindness and help on this occasion and during a subsequent visit in 1958. I also wish to thank the Directors of the Scottish National Museum, the Swedish State Museum, the Hamburg Museum, the Berlin Museum and the U.S. National Museum for sending me South African specimens lodged in their respective institutions.

One of the most important results of this sort of work was a general review of the genus *Diopatra*, which has been reported, not only from South Africa, but also from many other parts of the world under the name *Diopatra neapolitana*. An examination of material from the type locality (Naples) showed that the great majority of the records are misidentifications. A general discussion of *Diopatra* will be found on p. 338; the point which is stressed here is that similar work on difficult genera such as *Eulalia*, *Exogone*, *Autolytus*, and *Lumbrineris* suggests that a re-examination of type material or, where this is lacking, of material from the type locality is well worth while. It will lead to the solution of many anomalies of distribution and it now seems very probable that species of Polychaeta are by no means as widespread as has been supposed. Distribution patterns in this group will probably be found to follow the lines which Ekman (1953) has proposed for the bulk of the marine fauna.

There is no doubt that many new species of errant polychaets await discovery in Cape waters. The University now has its own research vessel and almost every dredging brings up species new to the area or new to science and the deeper waters off the Eastern Cape have hardly been explored. For this reason no systematic key is included in this paper although one has been produced and is constantly being revised. Further work on errant species must wait until the bulk of the sedentary species has been described. This will form the subject of the next paper in this series.

Station Lists

I must apologize for not giving the full station data below each species. It is realized that this causes a certain amount of inconvenience but space does not permit the full collection data to be repeated in this way. Full details for each dredging or diving station are given below, and under each species will be found only the station number with the number of specimens in brackets, e.g. AFR.728(1) under *Aphrodite alta* means that 1 specimen was obtained by R.S. *Africana II* and reference to the station list will give full details of date,

position, depth and type of bottom in the conventional abbreviated form. The sequence of the station lists is from the west or Atlantic coasts around the Cape towards the Eastern Province and Natal although some of the Africana (AFR) and Trawler (TRA) stations cover a wide range of coastline. In some cases the number of specimens obtained at a particular station was not accurately counted but was noted as common indicated as (c), fairly common (fc), or merely present (p). These letters in brackets are thus shown against the relevant dredging stations.

The types described in this paper will be deposited in the South African Museum, Cape Town.

The Trustees of the Museum gratefully acknowledge the grant in aid of publication of this paper received from the South African Council for Scientific and Industrial Research.

Station Data

Lambert's Bay Dredging (LAM)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
LAM. 1	16.1.57	32.04.3S/18.18.2E	15	S.
LAM. 4	do.	do.	do.	do.
LAM. 5	17.1.57	32.04.5S/18.18.E	17	Sh.R.
LAM. 6	17.1.57	32.04.7S/18.18.5E	9	S. R.
LAM. 8	18.1.57	32.05S/18.17.9E	23	S. Sh. R.
LAM. 10	17.1.57	32.04.7S/18.17.7E	23	S. Sh.
LAM. 11	18.1.57	32.05S/18.17.7E	29	S. Sh.
LAM. 13	19.1.57	32.04S/18.18.1E	18	R.
LAM. 15	18.1.57	32.05S/18.17.7E	17	S. Sh. R.
LAM. 16	17.1.57	32.04.8S/18.18.2E	11	S.
LAM. 17	17.1.57	32.05.3S/18.17.4E	23	S.
LAM. 18	18.1.57	32.04.8S/18.17.8E	17	R.
LAM. 19	do.	do.	do.	do.
LAM. 22	17.1.57	32.07.5S/18.17.6E	20	S. R.
LAM. 23	17.1.57	32.04.1S/18.18.6E	15	S. Sh.
LAM. 24	16.1.57	32.04.6S/18.18.2E	17	R.
LAM. 25	17.1.57	32.04.2S/18.18.4E	8	S. Sh. R.
LAM. 26	18.1.57	32.04.9S/18.17.5E	27	S. Sh. R.
LAM. 27	16.1.57	32.04.1S/18.18.4E	16	R.
LAM. 31	19.1.57	32.05.1S/18.17.7E	20	R.
LAM. 33	19.1.57	32.05.2S/18.17.5E	Plankton sample.	
LAM. 35	19.1.57	32.05.5S/18.17.7E	27·5	Sh. R.
LAM. 38	19.1.57	32.05.4S/18.17.7E	27	S. Sh.
LAM. 39	19.1.57	32.05.4S/18.17.6E	30	S. Sh.
LAM. 40	19.1.57	32.05.5S/18.17.6E	28	S. Sh.
LAM. 41	21.1.57	32.05S/18.17.7E	20	S. Sh.
LAM. 43	21.1.57	32.04.9S/18.18.2E	13·5	S. R.
LAM. 44	21.1.57	32.04.7S/18.17.6E	20	R.
LAM. 45	21.1.57	32.05S/18.18.2E	8	S. R.
LAM. 47	21.1.57	32.04.4S/18.17.7E	23	R.
LAM. 48	22.1.57	32.04S/18.17.9E	27	S. Sh.
LAM. 49	21.1.57	32.04.8S/18.18.1E	10	S. R.
LAM. 51	23.1.57	32.08.5S/18.17.7E	16·5	S. R.

Lambert's Bay Dredging (LAM)

No.	*Date*	*Position*	*Dept* (Metres)	*Bottom*
LAM. 52	21.1.57	32.04.7S/18.18.2E	17	S.
LAM. 54	23.1.57	32.09S/18.17.8E	19	R.
LAM. 55	22.1.57	32.04.2S/18.17.7E	27	S. Sh.
LAM. 56	23.1.57	32.11S/18.18.1E	18·5	S.
LAM. 57	23.1.57	32.10S/18.18.1E	25	S. R.
LAM. 59	23.1.57	32.09S/18.18E	16	S. R.
LAM. 60	23.1.57	32.02S/18.18E	27·5	f.S.
LAM. 61	23.1.57	32.12S/18.17.9E	28·5	S. Sh. R.
LAM. 63	23.1.57	32.01.5S/18.18E	25	Sh. R.
LAM. 64	23.1.57	32.01.5S/18.17.8E	29	S.
LAM. 66	19.1.57	32.05.5S/18.17.7E	27·5	Sh. R.

Saldanha Bay Dredging (SB)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
SB.113	13.7.46	33.00.7S/17.59.8E	10	S.
SB.114	do.	33.00.4S/17.57.5E	5	S.
SB.115	do.	do.	do.	do.
SB.116	do.	33.00.1S/17.59.2E	7	S.
SB.117	do.	33.00.3S/17.58.5E	7	S. R.
SB.118	14.7.46	33.01.5S/17.58E	9	S. Sh. R.
SB.119	do.	33.02.8S/18.01.2E	13	R.
SB.120	do.	33.03.4S/18.01.8E	9	S.
SB.121	do.	33.05S/18.01.4E	7	Sh.
SB.122	do.	33.04.9S/18.00.4E	5	S.R.
SB.125	9.4.53	33.01.4S/17.57.7E	11	S.
SB.127	do.	33.04.6S/17.59.8E	5·5	S. R.
SB.129	do.	33.04.5S/18.00E	6·5	do.
SB.130	do.	33.04.6S/18.00.6E	6	do.
SB.132	26.3.53	33.04S/17.59.3E	8·5	do.
SB.135	6.5.54	33.03S/17.58.6E	22	S.
SB.136	do.	33.03S/18.00.5E	14·5	do.
SB.143	28.4.47	33.05.1S/18.01.2E	6	S. Alg.
SB.144	do.	33.05.3S/18.01E	5·5	S.
SB.145	do.	33.04.8S/18.00.5E	7	S. Alg.
SB.173	2.5.58	33.05.1S/18.01.5E	4	S. R.
SB.175	27.4.59	33.02.8S/18.00.6E	15	Sh. kh. S. R.
SB.177	do.	33.03S/18.00.9E	do.	do.
SB.179	28.4.59	33.03.6S/18.00.4E	do.	S. Sh. R.
SB.180	do.	33.03.5S/17.58.5E	25·5	bl. M.
SB.181	do.	33.01.6S/17.59.3E	13	Sh. S.
SB.183	29.4.59	33.02.5S/17.58.7E	do.	co. S. Sh.
SB.184	29.4.59	33.01.5S/17.58.8E	do.	kh. S.
SB.189	30.4.59	33.01.1S/18.00.3E	9·5	do.
SB.193	30.4.59	33.00.7S/17.58.4E	8	do.
SB.195	1.5.59	33.03.5S/17.59.2E	20	R. S.
SB.197	do.	33.04.4S/17.56.4E	35	R.
SB.199	do.	33.01.7S/18.01.4E	9	kh. S.
SB.202	2.5.59	33.03.5S/17.57.5E	31	do.
SB.203	do.	33.05.5S/17.55.5E	56·5	kh. M.
SB.205	do.	33.03.6S/17.56.4E	40	kh. M. Sh.
SB.207	do.	33.02.5S/17.57.5E	27·5	S. Sh.
SB.208	do.	33.01.9S/17.56.3E	15	kh. S. Sh.

Langebaan Lagoon Dredging (LB)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
LB.155	15.7.46	33.07.1S/18.02.4E	2	f. S.
LB.158	do.	33.09S/18.04.2E	4	do.
LB.159	do.	33.10S/18.04.8E	4·5	f. S. M.
LB.160	do.	33.06.4S/18.01.9E	8	S. Sh.
LB.161	16.7.46	33.05.6S/18.00.8E	5	Sh. R.
LB.169	24.4.49	33.10.5S/18.03.8E	2	f. S.
LB.190	do.	33.11.3S/18.05.5E	0–2	f. S. M.
LB.191	do.	do.	do.	do.
LB.239	2.5.51	33.07S/18.02.7E	2	f. S.
LB.299	5.5.51	33.06.8S/18.01E	2·5	S. Sh.
LB.300	do.	33.07.6S/18.02.3E	3	S.
LB.323	do.	33.06.8S/18.01E	2·5	S. Sh.
LB.363	do.	33.07.1S/18.02.7E	4	S
LB.364	do.	33.05.9S/18.01.7E	5	S. Sh.
LB.380	7.5.53	33.06.3S/18.01E	4·5	do.
LB.382	do.	33.05.5S/18.01.6E	12·5	do.
LB.391	8.5.53	33.07.9S/18.02.1E	2·5	f. S.
LB.456	2.5.55	33.07.7S/18.02.4E	4	S. Sh.
LB.472	6.5.55	33.07.4S/18.02.5E	3·5	do.
LB.496	3.5.56	33.05.7S/18.01E	5	Gr. R.

Table Bay Dredging (TB)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
TB.301	4.8.46	33.49.5S/18.27.5E	12·8	S. Sh. R.
TB.302	11.2.47	33.48.3S/18.24E	11	S. St.
TB.303	do.	33.47.5S/18.24.3E	19·5	S. Sh. St.
TB.304	do.	33.48S/18.24.3E	16	Sh. Gr.
TB.305	26.6.47	33.52.7S/18.29.7E	9	S. St.
TB.306	3.7.47	33.50.1S/18.27.8E	17	Sh. R.
TB.307	do.	33.50.3S/18.28E	15·5	R. Sh.
TB.308	do.	33.51.2S/18.27.3E	23	S.R.
TB.309	do.	33.52.7S/18.26.8E	20·5	R.
TB.310	25.11.48	33.48S/18.21E	16·5	S.
TB.312	15.9.49	34.05S/18.21E	11	do.
TB.313	25.10.46	33.52S/18.28E	17	S. Sh.
TB.314	15.12.57	33.48.6S/18.24.6E	15	Sh. St.
TB.315–333	do.	do.	do.	do.

Ships' Hulls and Experimental Plates Submerged in Table Bay Docks (SH)

Code No.	*Date*	*Remarks.*
SH. 69	12.11.46	*Norfolk* from India and east coast of Africa.
SH. 71	17.4.46	*Natal*—from India and east coast of Africa.
SH. 74	18.4.46	*Windward*—local wooden yacht 9 months in water.
SH.134	21.1.47	*Empire Liddell*—local ship 1 month in water.
SH.168	1.4.47	Experimental plate submerged for 120 days.
SH.204	27.5.47	Experimental plate submerged for 175 days.
SH.277	4.9.47	Experimental plate submerged for 275 days.
SH.324	6.2.48	Barge working in Table Bay.
SH.366	2.12.48	Wooden *Teredo* trap submerged for ? days.
SH.376	26.1.49	Experimental plate submerged for 96 days.
SH.393	16.3.49	Wooden frame submerged for 94 days.
SH.400	do.	Experimental plate submerged for 7 months 2 days.

Ship's Hulls and Experimental Plates Submerged in Table Bay Docks (S.H.)

Code No.	*Date*	*Remarks.*
SH.415	14.2.49	Wooden frame submerged for over 1 year.
SH.427	15.12.49	Experimental barge 14 months in water.
SH.428	29.7.53	Scraping from submerged caisson.
SH.430	28.7.58	*Leeukop*—local wooden trawler. 8½ months in water.

West Coast Dredging (WCD)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
WCD. 3	25.2.59	34.09.8S/18.16.5E	78	R.
WCD. 5	do.	34.09S/18.14.8E	110	bl. S. M.
WCD. 8	24.3.59	34.09.35S/18.17.5E	43	R.
WCD.13	do.	34.09.4S/18.16.5E	75	do.
WCD.15	24.4.59	33.04.3S/17.54.7E	51	kh. M.
WCD.19	29.4.59	33.05.6S/17.54.5E	64	do.
WCD.21	30.4.59	33.04.5S/17.55.5E	49	do.
WCD.23	1.5.59	33.06.4S/17.53.7E	79	do.
WCD.26	do.	33.06.5S/17.55.4E	86	d. gr. M.
WCD.28	2.5.59	33.05.5S/17.56.4E	42	kh. M.

False Bay Dredging (FB)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
FB.301	8.7.46	34.08S/18.27E	22	S. Pyura.
FB.302	8.9.46	34.08.5S/18.26.5E	8	S.
FB.305	12.11.46	34.08S/18.27E	12	S. Sh.
FB.306	24.11.46	34.09.3S/18.27.7E	22	S. Sh. Alg.
FB.307	22.2.47	34.07.5S/18.31E	27·5	R.
FB.308	do.	34.08S/18.31.5E	do.	f. S. Sh.
FB.309	do.	34.07.5S/18.29.3E	19·5	S. Sh.
FB.310	21.4.47	34.08S/18.32E	27·5	S.
FB.311	28.4.47	34.10S/18.27.8E	24	S. lithoth.
FB.312	do.	34.09.5S/18.27E	17	do.
FB.313	18.6.47	34.08S/18.29E	25	S. Sh.
FB.314	8.9.46	34.09S/18.27.7E	14	S. *Pyura*
FB.316	29.4.48	34.09S/18.28E	23	S.
FB.317	do.	34.09.5S/18.28.3E	22	do.
FB.318	do.	34.10.2S/18.27E	27	do.
FB.319	do.	34.09.2S/18.26.8E	22	do.
FB.320	26.9.48	34.08S/18.29.6E	18	S. Sh.
FB.321	do.	34.08S/18.31E	24	do.
FB.322	do.	34.07S/18.29E	19	R. S. Sh.
FB.323	30.1.47	34.10S/18.29.5E	30	f. S.
FB.324	do.	34.09S/18.29.5E	25	S. Sh.
FB.325	9.3.50	34.08.5S/18.27E	14	S. *Pyura*
FB.326	5.4.50	34.08.9S/18.27.4E	15	do.
FB.327	27.8.51	34.09.6S/18.26.6E	17	R.
FB.328	do.	34.09.8S/18.26.1E	?9	S.
FB.329	do.	34.10.2S/18.26.2E	14	S. Sh.
FB.330	do.	34.10.1S/18.26.1E	9	S.
FB.331	do.	34.10S/18.26.1E	10	R. S.
FB.332	do.	34.09.3S/18.26.4E	11	do.
FB.333	20.9.50	Off St. James	16·4	S. R.
FB.334	26.9.48	34.07.5S/18.29E	22	S. Sh.

False Bay Dredging (FAL)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
FAL. 5	22.2.52	34.09.5S/18.35E	35	S. Sh.
FAL. 8	do.	34.08.3S/18.35.3E	24	R.
FAL. 15	5.3.52	S.E. Oatland Pt.	8–9	R. S.
FAL. 16	do.	do.	do.	do.
FAL. 17	do.	do.	do.	do.
FAL. 21	do.	34.13S/18.28E (plankton)	11–12	S. Sh.
FAL. 22	do.	do.	do.	do.
FAL. 23	do.	do.	do.	do.
FAL. 26	do.	34.13S/18.29E	15–21	S. Sh. R.
FAL. 27	do.	do.	do.	do.
FAL. 29	do.	34.13S/18.29E	28	S. Sh.
FAL. 30	do.	34.12S/18.29E	33–36	Sh.
FAL. 31	do.	do.	do.	do.
FAL. 34	18.6.52	34.05S/18.44E	7	S. R.
FAL. 43	25.6.52	34.09.6S/18.49.2E	21·5	do.
FAL. 44	do.	do.	do.	do.
FAL. 50	do.	34.09.3S/18.49.6E	18	R. S.
FAL. 51	do.	do.	do.	do.
FAL. 56	do.	34.09.4S/18.50.8E	8	R.
FAL. 57	do.	do.	do.	do.
FAL. 58	do.	34.09.4S/18.50.4E	12	S. R.
FAL. 63	29.7.52	34.17.5S/18.49.2E	22	S.
FAL. 65	do.	34.17.3S/18.48.7E	37–38	S. Sh.
FAL. 69	do.	34.17.2S/18.49.4E	16–19	R.
FAL. 70	do.	do.	do.	do.
FAL. 80	do.	34.16.5S/18.49.5E	14–17	do.
FAL. 81	do.	do.	do.	do.
FAL. 82	do.	do.	do.	do.
FAL. 95	17.9.52	34.10.6S/18.47.3E	36	S. Gr. R.
FAL.103	22.2.52	34.08.3S/18.35.3E	24	R.
FAL.104	25.6.52	34.09.4S/18.50.4E	12	S. R.
FAL.105	5.3.52	34.13S/18.29E	15–21	S. Sh. R.
FAL.106	17.9.52	34.10.6S/18.47.3E	36	S. Gr. R.
FAL.107	23.1.53	34.09.4S/18.51.7E	1·5–2·5	S.
FAL.110	do.	34.09.3S/18.51E	8–12	R. S.
FAL.111	27.1.53	Windmill Beach (diving)	4–5	R.
FAL.113	do.	do.	do.	do.
FAL.114	do.	do.	do.	do.
FAL.117	12.2.53	Simons Bay	23·5	Lithoth.
FAL.122	17.2.53	Glencairn (diving)	?7	R.
FAL.126	do.	do.	2–4	do.
FAL.127	do.	do.	2–7	do.
FAL.128	do.	do.	do.	do.
FAL.131	26.2.53	Oatland Pt. (diving)	1–2	do.
FAL.132	27.2.53	do.	0–2	do.
FAL.134	do.	do.	do.	do.
FAL.136	do.	do.	do.	do.
FAL.137	4.3.53	Gordons Bay Quay (diving)	0–4	do.
FAL.144	9.3.53	Oatland Pt. (diving)	0–5	do.
FAL.145	do.	do.	do.	do.
FAL.149	12.3.53	do.	4·5–5·5	S. R.
FAL.152	do.	do.	do.	do.
FAL.155	21.4.53	do.	0–3	R.
FAL.156	do.	do.	do.	do.
FAL.159	do.	do.	do.	do.

False Bay Dredging (FAL)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
FAL.161	23.5.53	Oatland Pt. (diving)	0–2	S. R.
FAL.162	do.	do.	do.	do.
FAL.164	do.	do.	do.	do.
FAL.166	10.6.53	do.	2–4	do.
FAL.171	do.	do.	4–6·5	do.
FAL.174	do.	do.	do.	do.
FAL.178	9.8.53	do.	4	do.
FAL.182	8.9.53	do.	?5	do.
FAL.184	11.9.53	34.22.1S/18.35.2E	73	S. Sh. Gr.
FAL.185	do.	do.	do.	do.
FAL.187	10.9.53	34.12.8S/18.36.5E	46	S. Sh.
FAL.204	9.9.53	34.07.1S/18.35.6E	(larva trap, night)	
FAL.205	10.9.53	34.17.6S/18.39.2E	62	S. Sh.
FAL.206	do.	do.	do.	do.
FAL.207	do.	34.09.9S/18.42.4E	36·5	S. R.
FAL.209	do.	34.06.8S/18.40.3E	29	S. Sh.
FAL.211	9.9.53	34.07.1S/18.35.6E	21·7	S. Sh. R.
FAL.214	10.9.53	34.12.4S/18.43.5E	42	S. R.
FAL.216	do.	do.	do.	do.
FAL.219	9.9.53	34.07S/18.32.5E	18	S. Sh. R.
FAL.223	do.	34.13.9S/18.31.6E	40	co. S. Sh.
FAL.225	do.	do.	do.	do.
FAL.226	do.	34.10.5S/18.32.4E	36	S.
FAL.228	do.	34.20.3S/18.31.8E	64	do.
FAL.229	do.	do.	do.	do.
FAL.231	do.	34.17.4S/18.31.4E	49	S. R.
FAL.233	10.9.53	34.15.3S/18.44.8E	48	S. Sh. Gr. R.
FAL.235	do.	34.18.2S/18.45.8E	55	R.
FAL.236	do.	34.21.1S/18.46.8E	64	do.
FAL.237	do.	34.22.7S/18.43.1E	79	gn. M.
FAL.238	do.	34.20.6S/18.39.4E	82	S. gn. M.
FAL.240	do.	34.23.7S/18.40.9E	88	gn. M.
FAL.241	11.9.53	34.18.5S/18.34.2E	64	S. M. Sh.
FAL.242	do.	do.	do.	do.
FAL.243	do.	34.22.5S/18.37.3E	80	S. Sh.
FAL.245	21.4.53	Oatland Pt. (diving)	0–3	R.
FAL.246	9.8.53	do.	4	do.
FAL.247	9.9.53	34.07S/18.32.5E	18	S. Sh. R.
FAL.248	do.	34.07.1S/18.35.6E	21·7	do.
FAL.249	do.	34.07S/18.32.5E	18	do.
FAL.250	10.9.53	34.22.7S/18.43.1E	79	gn. M.
FAL.251	do.	34.23.7S/18.40E	88	do.
FAL.256	17.11.53	Oatland Pt. (diving)	4–5·5	R.
FAL.257	do.	do.	2·5–5·5	do.
FAL.258	21.11.53	do.	10·5	S. Sh.
FAL.260	do.	Noah's Ark (diving)	14	S. Sh. M.
FAL.262	do.	do.	11–14	R.
FAL.266	27.1.53	Windmill Beach (diving)	4–5	do.
FAL.269	18.9.54	Roman Rock (diving)	14–17	do.
FAL.275	21.9.54	do.	do.	do
FAL.280	23.9.54	do.	12–14	do.
FAL.283	do.	do.	do.	S. Sh.
FAL.284	do.	do.	do.	do.
FAL.302	8.10.02	34.23S/18.36E (S.A. Museum material)	35	R.

False Bay Dredging (FAL)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
FAL.303	9.10.02	34.26S/18.37E (S.A. Museum material)	73	R.
FAL.304	15.10.1897	34.09.4S/18.49.5E (S.A. Museum material)	18	do.
FAL.306	11.9.53	34.22.1S/18.35.2E	73	S. Sh. Gr.
FAL.314	19.4.55	34.09.6S/18.27.4E	26	S.
FAL.324	6.10.1898	34.18S/18.?E (S.A. Museum material)	?	?
FAL.327	10.9.57	Kalk Bay	3–4	R.
FAL.328	31.1.59	34.19S/18.34.6E	40	S. Sh.
FAL.334	do.	34.15S/18.36E	51	co. S. Sh.
FAL.338	do.	34.13S/18.35E	44	S.
FAL.341	do.	34.11S/18.35.5E	do.	f. br. S.
FAL.345	do.	34.11S/18.33.5E	38	f. S.
FAL.347	do.	34.10.8S/18.31E	35	do.
FAL.349	do.	34.08.7S/18.31.6E	27	w. S.
FAL.352	1.2.59	34.23.3S/18.40.3E	88	gn. M.
FAL.355	24.2.59	34.23.3S/18.39.4E	97	S.R.
FAL.357	do.	34.18.8S/18.39E	73	co. S. Sh.
FAL.359	do.	34.16.8S/18.40.9E	62	S. Sh.
FAL.365	25.2.59	34.09.2S/18.46.6E	30	R.
FAL.367	do.	34.11.1S/18.46.9E	37	S.R.
FAL.371	do.	34.12.6S/18.46.7E	40	R.
FAL.373	do.	34.15.1S/18.44.8E	54	S. Sh.
FAL.375	do.	34.16.8S/18.42.8E	60	gn. S. Sh.
FAL.376	do.	34.18.7S/18.37.2E	72	do.
FAL.378	do.	do.	do.	do.

Material From Commercial Trawlers (TRA)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
TRA. 20	5.5.46	33.48S/17.35E	311	gn. M.
TRA. 21	4.9.46	34.25S/18.10E	301	M. R.
TRA. 25	8.4.48	34.30S/20.54E	66	S. M.
TRA. 27	21.7.48	34.48S/20.20E	67	do.
TRA. 30	9.11.47	34.49S/20.21E	86	M. R.
TRA. 33	20.7.49	34.55S/21.10E	90	S. R.
TRA. 36	21.1.50	34.35S/20.50E	73	M. St.
TRA. 40	–.7.50	34.30S/20.57E	do.	do.
TRA. 41	26.7.51	34.31S/20.50E	66	S. M.
TRA. 43	?	29.49S/31.48E	770	M.
TRA. 46	24.9.52	31.25S/16.20E	366	gn. M.
TRA. 48	do.	31.15S/16.00E	415	M. S.
TRA. 52	do.	32.12S/16.38E	394	M.
TRA. 54	28.11.52	34.40S/21.35E	73	S. R.
TRA. 55	do.	do.	do.	do.
TRA. 56	do.	do.	do.	do.
TRA. 58	26.11.52	34.28S/21.45E	70	S. St.
TRA. 62	25.11.52	34.30S/21.15E	62	S. M.
TRA. 63	28.11.52	34.26S/21.50E	64	S. M. R.
TRA. 68	6.2.53	32.24S/18.07E	69	gn. M.
TRA. 69	do.	(plankton) 32.45S/18.00E	15	S. R.
TRA. 70	do.	32.29S/18.02E	27	M.
TRA. 71	5.2.53	32.05S/18.14E	66	R. S.

Material From Commercial Trawlers (TRA)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
TRA. 73	3.2.53	32.06S/16.37E	311	gn. M.
TRA. 74	5.2.53	32.05S/17.52E	123	do.
TRA. 75	do.	do.	do.	do.
TRA. 77	6.2.53	32.41S/18.03E	27	S. M.
TRA. 80	4.2.53	32.23S/17.48E	143	gn. M.
TRA. 84	13.11.51	32.37S/18.17E	6	S.
TRA. 85	22.3.53	32.44S/18.02E	18	do.
TRA. 86	23.3.53	32.48S/17.58E	9	do.
TRA. 88	do.	32.44S/18.00E	11	do.
TRA. 89	do.	32.45S/18.03E	9	S. R.
TRA. 91	15.7.53	33.51S/25.50E	46	M.
TRA. 93	–.1.54	35.03S/21.50E	110	S. R.
TRA. 94	do.	do.	do.	do.
TRA.102	–.3.56	34.25S/21.30E	55	S. R. Polyz.
TRA.104	6.8.56	34.31S/19.21E	22	S.
TRA.106	do.	34.33S/19.19E	37	do.
TRA.107	7.8.56	34.10S/18.48E (surface plankton)	29	?
TRA.108	6.8.56	34.33S/19.19E	37	S.
TRA.110	8.9.56	34.19S/18.32E	58	S. Sh. R.
TRA.112	do.	34.19S/18.33E	60	S. R.
TRA.113	do.	34.19S/18.32E	58	do.
TRA.114	do.	34.19S/18.33E	62	do.
TRA.115	29.11.56	34.15S/18.43E	54	S.
TRA.116	do.	34.11S/18.39E	44	do.
TRA.121	25.1.57	34.12S/18.44E	37	S. R.
TRA.122	do.	34.13.5S/18.45E	44	S.
TRA.123	do.	34.12S/18.45E	40	S. R.
TRA.127	23.2.57	34.19S/18.30E	51	do.
TRA.132	–.2.57	34.20S/18.30E	55	Phyllochaetopterus tubes S. Sh. R.
TRA.133	do.	do.	do.	do.
TRA.135	23.2.57	34.19S/18.30E	52	do.
TRA.143	27.3.57	34.18S/18.31E	51	do.
TRA.151	6.3.58	34.51S/19.55E	22	R.
TRA.152	do.	do.	do.	do.

Dredging by S.A. Fisheries Research Vessel *Africana II* (AFR)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
AFR.689	?	32.36.6S/16.44E	391	gn. M.
AFR.691	8.5.47	32.38S/16.52E	347	Cl. S.
AFR.707	26.5.47	31.40S/16.55E	287	d. gn. M.
AFR.718	19.6.47	32.09S/18.06E	108	do.
AFR.723–5–7	10.8.47	31.30S/17.00E	366	?
AFR.728	15.8.47	31.14S/16.36E	272	Polyz. R.
AFR.730	do.	31.30S/16.03E	459	y. Cl. S. R.
AFR.736	17.8.47	30.42S/15.59E	201	co. gn. S. Sh.
AFR.761	10.9.47	30.13S/15.18E	260	Gr. S. R.
AFR.773	14.9.47	28.52S/14.50E	194	Cl. S.
AFR.775	15.9.47	29.16S/14.48E	238	Cl. S. R.
AFR.783	24.9.47	32.43S/17.31E	222	S. M.
AFR.789	28.9.47	33.05S/17.27E	408	bl. S. R.

Dredging by S.A. Fisheries Research Vessel *Africana II* (AFR)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
AFR.790	28.9.47	33.12S/17.40E	229	gn. M.
AFR.791	4.10.47	32.41S/17.18E	274	R. bl. S. M.
AFR.801	7.10.47	32.34S/17.52E	71	R. d. gn. M.
AFR.830	19.11.47	32.12S/18.42E	315	? R.
AFR.831	do.	35.15S/18.39E	547	Mn. Nod.
AFR.835	20.11.47	?35.09S/19.02E	188	M.
AFR.842	25.11.47	34.35S/19.18E	31–38	gr. S.
AFR.882	10.2.48	34.39S/18.42E	168	gn. M.
AFR.945	19.3.48	36.25S/21.08E	177	S. R.
AFR.950	20.3.48	36.44S/21.18E	201	bl. S. Sh.
AFR.957	22.3.48	35.13S/21.19E	111	co. S. St.
AFR.967	23.3.48	35.07S/20.49E	91	f. S.
AFR.994	19.4.48	34.35S/21.26E	68	co. S. Sh.
AFR.995	do.	34.29S/21.26E	64	gn. M.
AFR.1224	15.10.48	26.34S/15.04E	55	bl. M.
AFR.1335	13.11.48	25.51S/14.51E	60	gn. M.
AFR.1529	4.6.49	32.40S/17.43E	150	gn. M. R.
AFR.1532	do.	33.12S/17.58E	77	gn. M.
AFR.1535	9.7.49	29.09S/16.45E	84	M.
AFR.1544	23.7.49	29.17S/16.42E	117	gn. M.
AFR.1545	do.	29.09S/16.37E	119	gn. M. R.
AFR.1554	28.7.49	32.05S/18.17E	35	S. Sh.
AFR.1576	9.9.49	32.28S/18.06E	66	gn. M. R.
AFR.1578	do.	32.30S/17.49E	158	gn. M. S. R.
AFR.1579	do.	32.25S/17.42E	117	do.
AFR.1581	10.9.49	32.22S/17.59E	122	gn. M. R.

Mossel Bay Dredging (MB)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
MB. 4	12.1.56	34.09S/22.07.1E	10	S. Sh. R.
MB. 9	do.	34.04.2S/22.13.8E	19	R.
MB.13	do.	do.	do.	do.
MB.16	13.1.56	34.11S/22.10.1E	16	S. R.
MB.20	do.	34.08.5S/22.07.2E	13	S. Sh. R.
MB.23	do.	34.08.8S/22.07.3E	12·5	R.
MB.27	do.	34.11.1S/22.09.9E	19	do.
MB.34	15.1.56	34.08.3S/22.09.4E	31	S.
MB.37	16.1.56	34.09.3S/22.10E	do.	do.
MB.38	do.	34.10.1S/22.07.8E	8·5	do.
MB.40	do.	34.10.1S/22.08E	9	R.
MB.41	do.	do.	do.	do.
MB.42	do.	34.08.5S/22.08.8E	25	S. M.
MB.49	17.1.56	34.11.3S/22.10E	10	R.
MB.53	do.	34.11S/22.09.9E	14	R. S.
MB.56	do.	34.10.7S/22.09.6E	9	R.
MB.57	do.	do.	do.	do.
MB.58	18.1.56	34.04.3S/22.13.5E	12·5	do.
MB.59	do.	34.04.1S/22.13.9E	11·5	do.
MB.62	do.	34.04.3S/22.14.2E	18·5	co. S. Sh. R.
MB.66	do.	34.04.8S/22.13.1E	26	do.
MB.67	do.	do.	do.	do.
MB.68	19.1.56	34.09.1S/22.07.3E	13	S. Sh. R.

MOSSEL BAY DREDGING (MB)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
MB.69	19.1.56	34.08.6S/22.07.3E	13·5	S. R.
MB.74	do.	34.09.1S/22.07.2E	12	S. Sh. R.
MB.75	do.	34.08.7S/22.07.4E	15·5	S.
MB.77	20.1.56	34.11.3S/22.06.3E	24	S. R.
MB.78	do.	do.	do.	do.
MB.79	do.	34.05S/22.11.8E	19	M.
MB.81	do.	34.06.2S/22.10.9E	27·5	do.
MB.85	21.1.56	34.11.4S/22.10.1E	29	R.
MB.86	17.1.56	34.11.3S/22.10E	10	do.
MB.87	do.	34.11S/22.09.9E	14	R. S.
MB.88	18.1.56	34.04.8S/22.13.1E	26	co. S. Sh. R.

ALGOA BAY DREDGING (LIZ)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
LIZ. 1	5.4.54	33.55.7S/25.37.2E	9·5	M.
LIZ. 2	do.	do.	do.	do.
LIZ. 3	5.4.54	33.56.1S/25.40E	17·5	S.
LIZ. 6	6.4.54	33.58.1S/25.38.9E	9	R. St.
LIZ. 9	do.	do.	do.	do.
LIZ.13	do.	33.58.2S/25.38.8E	7·5	S.
LIZ. 18	7.4.54	33.58.4S/25.40.5E	14	St.
LIZ.19	do.	33.58.5S/25.42E	27	S. Sh.
LIZ.23	8.4.54	33.58S/25.43E	38·5	M. Cl.
LIZ.24	11.4.54	34.00.4S/25.44.5E	39	co. S. Sh.
LIZ.25	do.	do.	do.	do.
LIZ.27	do.	34.00.8S/25.42.4E	6	R.
LIZ.29	do.	do.	do.	do.

SOUTH COAST DREDGING (SCD)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
SCD. 1	15.4.58	35.27S/20.10E	150	M.
SCD. 3	18.4.58	34.20S/24.40E	102	R.
SCD. 4	do.	do.	do.	do.
SCD. 9	19.4.58	34.15S/25.05E	11	Sh. R.
SCD. 18	20.4.58	32.52S/28.12.5E	78	Cl. M.
SCD. 20	26.5.58	34.07.3S/23.23.8E	46	R.
SCD. 22	do.	?34.46S/23.27E	?110	?R.
SCD. 25	24.5.58	34.02.5S/25.46.5E	75	S. M.
SCD. 26	23.5.58	33.47S/26.04E	47	M. Sh.
SCD. 32	22.5.58	33.38.6S/26.54.7E	55	R.
SCD. 33	21.5.58	33.03S/27.56.2E	57	S. Sh.
SCD. 40	19.5.58	32.15.2S/28.57.7E	47	R.
SCD. 50	do.	31.38.8S/29.34.4E	do.	do.
SCD. 54	20.8.58	34.01S/25.45.5E	46	do.
SCD. 58	19.8.58	33.37S/26.56.6E	do.	S.R.
SCD. 61	16.8.58	33.02S/27.56.2E	do.	do.
SCD. 63	14.8.58	31.57.2S/29.36E	36	S. M.
SCD. 69	5.7.59	33.31S/27.14.5E	67	?S.
SCD. 72	15.7.59	31.41.7S/29.33.5E	90	glutinous br. M. and grass.

South Coast Dredging (SCD)

No.	*Date*	*Position*	*Depth* (Metres)	*Bottom*
SCD. 74	16.7.59	32.33S/28.38E	55	S. M.
SCD. 78	do.	32.37S/28.31E	49	br. S.
SCD. 80	do.	32.43S/28.28E	58	St. Sh.
SCD. 82	17.7.59	27.54S/33.03E	51	br. S. Sh.
SCD. 89	do.	33.03S/27.55E	27	R.
SCD. 94, 96	20.7.59	34.21S/25.41E	110	Sh.
SCD. 99	21.7.59	34.33S/24.01E	130	R.
SCD.100	do.	do.	do.	do.
SCD.103	22.7.59	35.07S/22.15E	120	m. S.
SCD.105	23.7.59	34.33S/21.28E	67	co. S. br. Sh.
SCD.106	do.	34.35S/21.10E	67	S. M.
SCD.109	do.	34.35S/21.11E	75	co. S. Sh. St.

Family *APHRODITIDAE*

Subfamily Hermioninae

Aphrodita alta Kinberg 1855

Aphrodite alta. Kinberg 1857, p. 2, pl. 1, fig. 1 *a–g*. Monro 1930, p. 36, fig. 5 *a–l*.
Aphrodita A near *alta* McIntosh 1925, p. 18.

Records: AFR.728(1), 835(1).

Notes: In this species the dorsal setae do not project through the felt, the eyes lack pigment, the ceratophore of the median antenna is short and stout but bears a very fine ceratostyle which is three-quarters the length of the prostomium. The ventral setae have curved, bearded tips.

Monro (1930) states that the median antenna is short and stout but this does not agree with Kinberg's pl. 1, fig. 1*b*, and it is probable that Monro was describing the ceratophore from which the ceratostyle had fallen. Again Monro's fig. 5*a* shows the stout dorsal setae as quite smooth. In mine they are covered with minute hairs.

McIntosh's specimens in the British Museum have been checked as identical with my own.

Subfamily Polynoinae

Harmothoe aequiseta (Kinberg) 1855

?*Lagisca extenuata* Ehlers 1913, p. 446.
Harmothoe aequiseta. Augener 1918, p. 137. Day 1953, p. 400.
Harmothoe crosetensis (non McIntosh) Monro 1930, p. 57 (partim).

Records: SB.118(1); TRA.71(1); FAL.16(1), 30(1), 44(5), 51(*p*), 56(4), 69(*p*), 80(*p*), 223(*p*); MB. 20(1), 57(1), 77(2); KNY.6(1), 11(1), 21(2).

Notes: The specimens reported by Monro (1930) from Simonstown as as *H. crosetensis* are definitely *H. aequiseta*. McIntosh described *H. crosetensis* as having fringed elytra but an examination of his type in the British Museum

shows that the surface of the elytron is densely covered with soft papillae right to the edge but the margins are not fringed. Monro's specimen of *H. crosetensis* from the South Shetland Islands agrees with McIntosh's type. The specimen recorded by Ehlers (1913) as *Lagisca extenuata* was a juvenile and should probably be referred to *H. aequiseta*.

Harmothoe africana Augener 1918

Harmothoe africana Augener 1918, p. 139, pl. 2, figs. 15–19, text fig. 6.

Records: FB.316(1).

Notes: Both *H. africana* and *H. goreënsis* (recorded below) are very closely allied to *H. aequiseta* if they are not mere varieties of the latter. In *H. aequiseta* the larger tubercles on the elytra look like straight dark thorns. In *H. africana* the larger tubercles are almost cylindrical and end in 2–4 points but there is considerable variation among the smaller ones.

Harmothoe goreënsis Augener 1918

Harmothoe goreënsis Augener 1918, p. 142, pl. 2, figs. 4–6; pl. 3, fig. 42, text-fig. 7.

Records: LAM.8(1), 22(3), 31(2), 44(1), 47(1), 57(1); SB.180(1), 183(3), 184(3), 189(1), 207(2); T.B.301(1), 306(1); WCD.8(1), 13(1); FAL.8(1), 58(*p*), 113(1), 134(5), 144(5), 149(2), 156(6), 216(1), 238(1), 280(4), 338(1), 341(1), 359(1), 375(1); MB.9(1), 13(2), 16(1), 27(3), 41(7), 49(12), 53(12), 56(2), 67(10), 69(1), 74(2); 77(6), 85(2); LIZ.2(6), 9(1), 18(4), 35(4), SCD. 40(1), 54(5), 58(5), 74(1).

Notes: This is a small species first recorded from shallow waters off Angola and Senegal. This is the first record from South Africa. It differs from *H. aequiseta* in having short, blunt, cylindrical or crown-shaped tubercles on the elytra instead of long sharp ones.

Harmothoe fraser-thomsoni McIntosh 1897

Harmothoe fraser-thomsoni. Fauvel 1923, p. 68, fig. 25 *a–e*. Day 1953, p. 400.

Records: SB.129(1), 132(1); LB.456(2); LIZ.6(1); SCD.58(1).

Notes: As stated earlier the South African material is a little different from typical European forms. The elytra have more numerous and crowded tumid papillae and the notosetae have long naked tips instead of short tips.

Harmothoe gilchristi n.sp.

(Fig. 1 *a–f*)

Records: AFR.835(2); FAL.355(1); SCD.22(1).

Description: The holotype is the single specimen from SCD.22. It is complete and measures 16 mm. by 3·5 mm. with 38 segments. The body is pale but there are brown markings on the elytra, antennae and dorsal cirri.

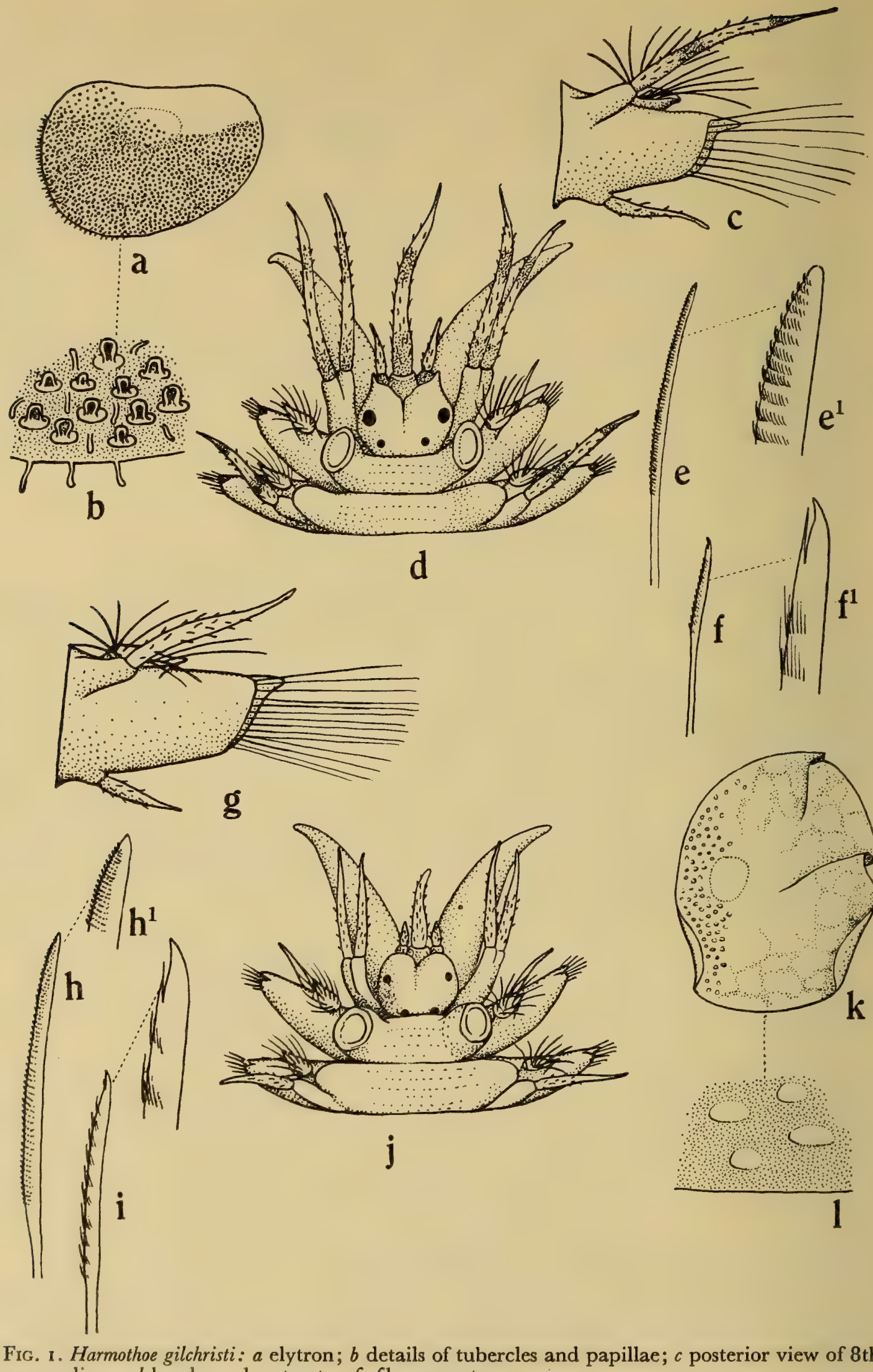

FIG. 1. *Harmothoe gilchristi: a* elytron; *b* details of tubercles and papillae; *c* posterior view of 8th parapodium; *d* head; *e*, e^1 notoseta; *f*, f^1 neuroseta.

Harmothoe agulhana: g posterior view of 8th parapodium; *h*, h^1 notoseta; *i*, i^1 neuroseta; *j* head; *k* elytron; *l* details of 'tubercles'.

The prostomium (fig. 1*d*) is almost square, slightly broader than long with very sharp prostomial peaks. The anterior pair of eyes are large and placed well back on the sides of the prostomium. The three antennae arise from short swollen cirrophores and all are brown, densely clad with long papillae and tapering. The median antenna of the holotype is missing but a specimen from AFR.835 shows that it is twice the length of the prostomium. The laterals on account of the very large prostomial peaks are markedly ventral in origin and each is well tapered and three-quarters the prostomial length.

The body is slightly tapered posteriorly and the last 6 segments lack elytra. The dorsal cirri are tapered, densely papillose and exceed the length of the neuropodia but not the neurosetae. Each has two dark bands of pigment. The elytra (fig. 1*a*) are large, circular, mottled with purplish-brown and cover the back except for the last few segments. Each has a very small fringe of unicellular papillae on the external margin and the surface (fig. 1*b*) is densely covered with short cylindrical or bollard-like tubercles plus a few elongate papillae. There are no large posterior vesicles.

The notopodium (fig. 1*c*) is well developed with a radiating tuft of numerous notosetae (fig. 1*e*). Each is stout and strongly serrated to the blunt grooved tip. The neuropodium is well developed with a pointed presetal lobe containing the aciculum and a truncate postsetal lip. The neurosetae (fig. 1*f*) are bidentate and have fairly long blades with about 15 rows of well-developed spinules and long naked tips (fig. 1*f*). The terminal tooth is broad with a curved point and the secondary tooth which lies in line with the shaft is exceedingly long and slender. Its length is almost twice the width of the shaft at the origin of the tooth and three-quarters the length of the terminal tooth.

H. gilchristi comes fairly close to *H. goreënsis* Augener but the prostomial peaks are better developed, the tubercles on the elytra are larger and most of them are swollen distally instead of being sculptured. Again, the notosetae have shorter, grooved tips which are rounded not pointed. The secondary tooth of the neuroseta is also distinctly longer. Type locality: Agulhas bank.

Harmothoe agulhana n.sp.

(Fig. 1 *g–l*)

Records: ?AFR.7070(1); FAL.365(1); MB.67(1); LIZ.25(1).

Description: The holotype is the single complete specimen LIZ.25 dredged in Algoa Bay. It is 12 mm. long by 2 mm. excluding setae and has 36 setigers. The body is narrowly oblong, hardly tapered posteriorly and is pale in alcohol with a faint network of brown on the exposed parts of the elytra.

The prostomium (fig. 1*j*) is about as broad as long with poorly marked frontal peaks. The eyes are rather small and the anterior pair is laterally situated almost half-way back. The tapered median antenna is as long as the prostomium but the laterals are very short and stumpy, barely a quarter of

the prostomial length. All antennae and cirri are sparsely beset with small papillae.

The dorsal cirri are tapered and on all except the last few segments they are shorter than the neurosetae. The ventral cirri are very small and distinctly tapered. The 15 pairs of elytra cover the body except for the last two segments. Individual elytra (fig. 1*k*) are large and oval and so thin that the edges tend to crumple. The colour is generally pale but there is a faint speckling or network of brown pigment over most of the surface. There is a patch of small rounded chitinous tubercles on the antero-medial margin, and a scattering of similar tubercles (fig. 1*l*) over the surface which do not have chitin-thickened walls and for this reason are not very obvious.

The notopodium (fig. 1*g*) is normally developed and the notosetae (fig. 1*h*) are fairly numerous but rather short and stout and strongly serrated to their blunt tips (fig. $1h^1$). The neuropodium is a truncate cone with a small presetal projection covering the end of the aciculum. The neurosetae (fig. 1*i*) have blades of normal length with about 10 rows of spinules. Apart from 2–3 superior neurosetae which are unidentate, the tips (fig. $1i^1$) are bidentate with a strong hooked terminal tooth and a fine secondary tooth.

A fragment of what may be the same species was obtained from station AFR.707. While generally similar, there are signs of prostomial peaks, the notosetae are very stout and have grooved tips and the neurosetae have more rows of spinules, so that both types of setae are very similar to those of *H. gilchristi*. But the short lateral antennae and the elytra are very like those of *H. agulhana* with only tiny hemispherical tubercles and entire margins.

This species appears to be related to *H. ljungmani*. The notosetae are similar and the elytra are not very different though the tubercles are not so well developed. The neurosetae, however, are quite distinct.

Harmothoe corralophila n. sp.

(Fig. 2 *a–f*)

Records: AFR.950(1); WCD.3(1), 13(3); FAL.378(1); SCD.100(1), 103(1).

Description: The type was selected from WCD.13. It is 15 mm. long with 37 segments. It is quite white in alcohol with rather glassy setae. The prostomium is bilobed and broader than long with obvious frontal peaks and rather large eyes. The anterior pair are half-way back and much wider apart than the posterior pair. The median antenna is twice as long as the prostomium and is mounted on a stout ceratophore from which an obvious ridge extends back along the dorsal surface of the prostomium for half of its length. The lateral antennae are tapered, markedly ventral in origin and equal to the prostomial length. All antennae and cirri are smooth. The palps are fairly large.

The elytra cover the whole length of the body. All of them are white and have entire margins without a sign of a fringe but the surface of the first few

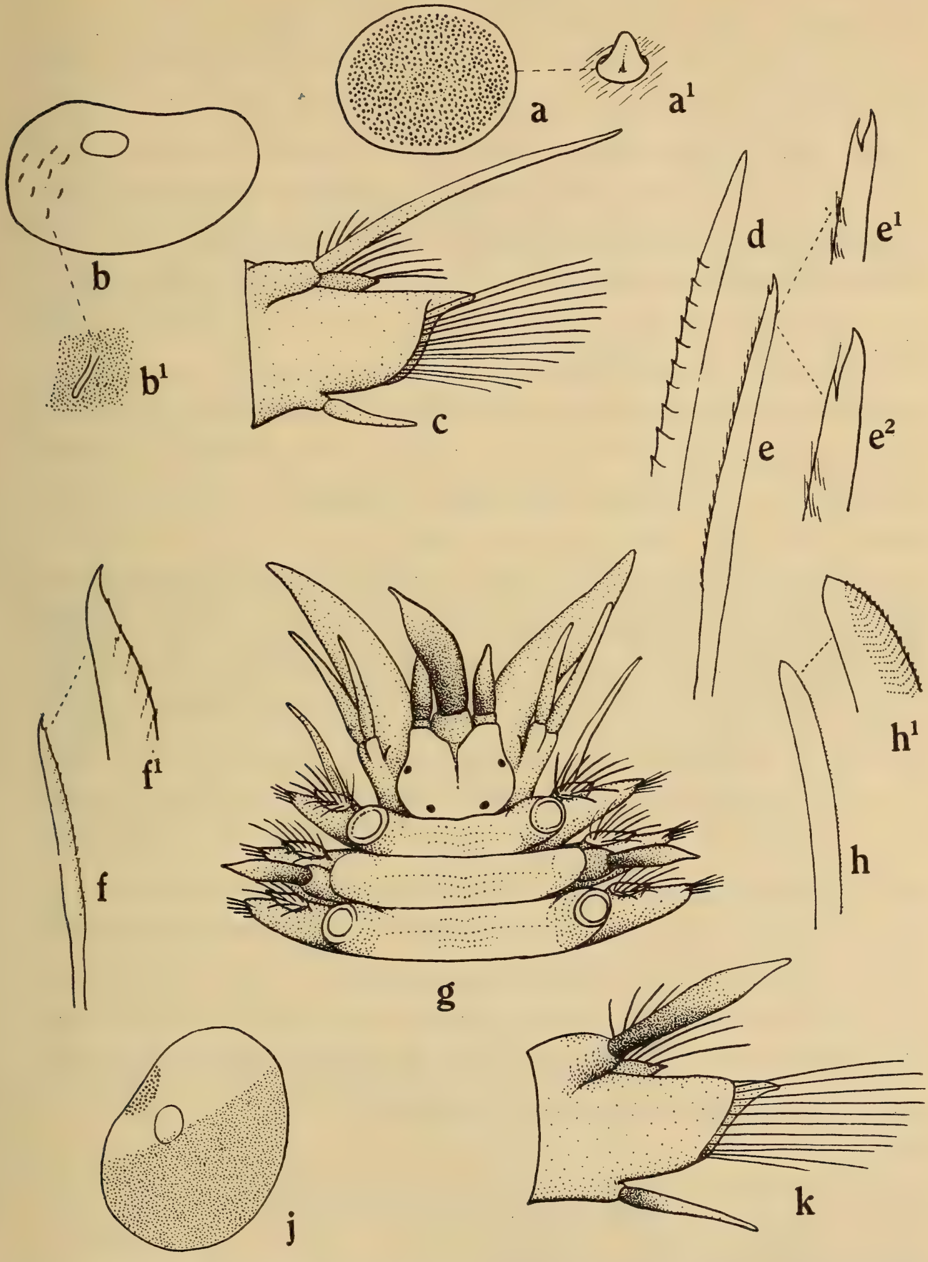

FIG. 2. *Harmothoe corralophila: a* first elytron; *a*[1] chitinous tubercle; *b* posterior elytron; *b*[1] soft papilla; *c* posterior view of parapodium; *d* notoseta; *e* neuroseta; *e*[1] tip of superior neuroseta; *e*[2] tip of middle neuroseta.

Malmgrenia purpurea: f neuroseta; *f*[1] tip of neuroseta; *g* head; *h* notoseta; *h*[1] tip of notoseta; *j* elytron; *k* posterior view of parapodium.

differs from more posterior pairs which at first sight appear to be quite smooth. The first pair (fig. 2*a*) are smaller than the rest, circular in outline and most of the surface is thickly chitinized and densely beset with numerous highly chitinized conical tubercles (fig. $2a^1$) plus a few indistinct soft cylindrical papillae. On some specimens there is only a narrow marginal belt around the elytron which is not thickly chitinized and free from tubercles but in others there is a relatively broad naked margin. The second pair of elytra has a more restricted area of thick chitin and tubercles and a larger area which is naked apart from the soft digitiform papillae. In the third and fourth pairs there are even smaller chitinized and tuberculate patches. All succeeding elytra (fig. 2*b*) are thin, entirely devoid of tubercles and have only a few indistinct papillae (fig. $2b^1$) on the otherwise smooth surface.

The dorsal cirri are smooth and tapered. The first few barely reach the ends of the neurosetae but further back they are longer. The notopodia are rather small and the notosetae (fig. 2*d*) are not very numerous but each is stout and well developed with widely spaced rows of large serrations or cusps preceding the long naked tip. Most of the notosetae are sharply pointed but some of the longer ones have grooved tips.

The neuropodium (fig. 2*c*) has a pointed presetal lip and a fan of long, clear, rather slender setae (fig. 2*e*). The spinules are poorly marked. Although there are actually 20 rows of spinules which is more than usual, the inferior neurosetae may at first appear to be smooth because the spinules lie so close along the blade. The terminal tooth is always well developed but the secondary tooth is very variable. In superior neurosetae (fig. $2e^1$) it is shorter but almost as broad as the terminal one so that the tip of the blade appears to be bifid. In middle neurosetae (fig. $2e^2$) the base of the secondary tooth is stout but the point is exceedingly fine and often bent or broken leaving a stout stump. No truly unidentate setae have been seen.

The first specimen obtained (AFR.950) has lost the anterior elytra and was provisionally identified as *Harmothoe joubini* Fauvel 1914 which it resembles in many respects apart from the anterior elytra and the tips of the neurosetae. Later several stylasterid corals (*Allopora bithalamus*) were obtained from SCD.100 with galls in the shape of open tunnels on their sides. *H. corralophila* was found in these galls and is obviously the cause of their formation. Since both ends of the tunnel are open it is probable that the worm can move in or out at will and uses the tunnel for protection.

Harmothoe lunulata (Delle Chiaje) 1841

Harmothoe lunulata. Fauvel 1923, p. 70, fig. 26.

Records: FAL.285(1).

Notes: This is a new record for South Africa.

Harmothoe saldanha Day 1953

Harmothoe saldanha Day 1953, p. 401, fig. 1 *a–d*.

Records: SB.202(1); SCD.32(1).

Harmothoe (Lagisca) waahli (Kinberg) 1855

Harmothoe waahli Monro 1933, p. 489, figs. 1–3.

Records: SB.121(4), 127(2); LB.155(2), 161(4); WCD.19(1); FB.302(1), 311(1), 319(1); FAL.43(2), 51(1), 58(1), 80(1), 235(1), 249(1), 269(1), 367(1); MB.16(1); LIZ.6(3).

Notes: Several authors have recorded this species under the generic name *Harmothoe* but it should be noted that the last 12 segments are narrowed and not covered by elytra. However I do not feel that this character merits full generic distinction.

Scalisetosus pellucidus (Ehlers) 1864

Scalisetosus pellucidus. Fauvel 1923, p. 74, fig. 27 *a–f*.

Records: LAM.1(1), 8(3), 25(1), 31(2), 63(1); SB.118(1), 119(1), 179(1); LB.161(1); TRA.71(1), 102(1); FB.302(1); FAL.8(*p*), 30(1), 95(*p*), 113(*p*), 122(1), 134(4), 166(1), 184(1), 275(1), 327(1), 338(1), 367(2); MB.40(1), 74(1), 86(1); KNY.6(1), 30(1); LIZ.9(1), 29(1), 35(1); SCD.9(2), 22(2), 100(1).

Antinoe lactea Day 1953

Antinoe lactea Day 1953, p. 403, fig. 2 *a–g*.

Records: LB.299(3), 300(1), 364(5).

Notes: It is surprising that this species has never been recorded outside Langebaan Lagoon.

Malmgrenia purpurea n. sp.

(Fig. 2 *f–k*)

Records: WCD.5(1); FAL.229(1), 359(1), 375(1).

Diagnosis: A purple species with very stout antennae and cirri.

Description: The type material consists of two complete but broken specimens dredged with *Spatangus capensis* from stations FAL.359 and FAL.375. The larger specimen measures 17 mm. and has 38 segments; the smaller specimen measures 10 mm. and has 37 segments. Both are purple in alcohol but many of the dorsal cirri and elytra are missing and some of the antennae as well. For this reason the description is based on both specimens.

The prostomium (fig. 2*g*) is rectangular and longer than broad with rather small eyes which are not easily distinguished against the purple background.

The anterior pair are set half-way back on the sides of the prostomium. At first sight it was thought that the insertion of the antennae was harmothoid and then it was noticed that prostomial peaks are absent and the lateral antennae are not ventral but subterminal in origin. When the worm was turned over it was further noted that there is a well developed facial tubercle and that the bases of the cirrophores which bear the lateral antennae are fused to the lower side of the prostomium but their distal ends incline upward so that the antennae appear to be almost terminal. This type of insertion is best termed subterminal but it should be noted that it is quite distinct from the so-called subterminal insertion of *Halosydna* where the lateral antennae arise from a lower level than the median antenna only because the latter is actually dorsal in origin. The median antenna here is terminal and it is a large dark almost club-shaped organ about as long as the prostomium. Its surface is quite smooth. The lateral antennae are similar in shape but only half as long. The palps are rather short and the tentacular cirri are rather stout. The tentacular segment bears a single seta.

There are 15 pairs of elytra which cover the dorsum. Each is broadly oval in shape (fig. 2*j*) and quite smooth except for a small patch of minute rounded tubercles on the anterior margin. There is no trace of a marginal fringe. The anterior half of each elytron is colourless where it is overlapped by the preceding one but the exposed posterior half is dark purple with clear cells here and there.

The dorsal cirri (fig. 2*k*) are similar to the antennae, being dark in colour, quite smooth and swollen distally before the tip. The notopodium bears about a dozen stout notosetae and the neropodium which has a pointed or triangular presetal lip and a shorter, more rounded post-setal lip bears some 20–30 rather short neurosetae. The ventral cirrus is smooth, evenly tapered and extends almost to the end of the neuropodium.

The notosetae (fig. 2*h*) are stout, very lightly serrated and end in abruptly pointed tips. Under high power the tiny close-set serrations produce a herring-bone pattern on the surface of the seta but individual serrations cannot be seen. The neurosetae (fig. 2*f*) have more slender shafts than the notosetae but the blades are of normal length and bear about 25 rows of very fine, transparent spinules. The tips (fig. $2f^1$) are short, the terminal tooth is sharp and well hooked but the secondary tooth is minute or even absent on some of the inferior neurosetae.

The pygidium bears a pair of dark sausage-like anal cirri.

Reference to Fauvel (1923) and Monro (1936) shows that the distinction between the genus *Malmgrenia* McIntosh 1876 and *Eulagisca* McIntosh 1885 is not clear. *Malmgrenia* as defined by Fauvel (1923) is generally similar to *Harmothoe* but differs in having the lateral antennae subterminal in origin, the notosetae very stout and faintly spinulose and the neurosetae either unidentate or with a minute secondary tooth. Fauvel in his definition states that the insertion of the antennae is similar to that of *Halosydna* but his figure of the head of *Malmgrenia castanea* shows that it is not similar to that of *Halosydna*

but the same as *M. purpurea* described above. *Eulagisca* was not defined by McIntosh (1885) but has been defined by Monro (1936) in terms which suggest that it is synonymous with *Malmgrenia*. However the figures of *Eulagisca corrientis* (the type species of *Eulagisca*) given by Monro (1930) show that the insertion of the antennae is similar to that of *Halosydna*, the notosetae strongly serrated and the neurosetae unidentate.

The present species *M. purpurea* may be distinguished from *M. castanea* by the position of the eyes, the possession of shorter and much stouter antennae and dorsal cirri and by the fact that the neurosetae are mainly bidentate. *M. castanea* is known to be commensal of the echinoid *Spatangus purpureus; M. purpurea* is probably a commensal of *Spatangus capensis*.

Lepidonotus durbanensis Day 1934

Lepidonotus durbanensis Day 1934, p. 18, fig. 1 *a–c*. Day 1951, p. 9.

Records: MB.86(1).

Notes: Only a single small specimen was obtained but it is quite distinct from the common *L. clava var. semitecta*. This is the most southerly record of this Natal form.

Lepidonotus clava (Mont.) var. *semitecta* Stimpson. 1855

Lepidonotus clava var. *semitecta*. Willey 1904, p. 256, pl. 13, fig. 4. Day 1953, p. 399.

Records: SB.207(1); LB.161(3); TB.302(1), 305(2), 309(1), 313(1), 317(1); TRA.122(1); WCD.8(3); False Bay—50 records on rock 0–73 metres, common; MB.9(2), 16(1), 23(1), 40(12), 49(12), 53(15), 56(2), 59(1), 62(6), 67(1), 85(3); KNY.21(1), 22(1); LIZ.2(2), 6(4), 18(*c*), 27(3); SCD.89(1).

Polynoe erythrotaenia (Schmarda) 1861

Hemilepidia erythrotaenia Willey 1904, p. 258, p. 13, figs. 6, 26.

Records: SB.179(1); TB.324(1).

Polynoe scolopendrina Savigny 1820

Polynoe scolopendrina. Fauvel 1923, p. 80, fig. 30. Day, 1953, p. 406.

Records: LAM.8(1), 13(1), 25(1), 31(4), 59(common), 63(1); LB.299(2); TRA.135(1); FAL.110(1), 122(*p*), 219(1), 345(1); MB.41(1), 53(1), 56(1), 67(1); LIZ.2(3), 6(1), 29(2); SCD.58(1).

?*Polynoe capensis* McIntosh 1885

Polynoe capensis McIntosh 1885, p. 114, pl. 4, fig. 4; pl. 15, fig. 1; pl. 19, fig. 4; pl. 9*a*, figs. 4 and 5.

Notes on the type material. No new specimens have come to hand, but the type specimens dredged from 98 fathoms off the Cape of Good Hope and

now in the British Museum (register number 1885 12.1.94) were re-examined. The type material consists of blackened fragments of two specimens and several loose elytra. The median antenna is missing and the lateral antennae which are terminal in origin, are two-thirds the length of the prostomium. The anterior pair of eyes are slightly larger than the posterior pair and are dorsal in position. The total number of elytra originally present cannot now be determined but one posterior fragment shows 8 posterior segments without elytra scars. The loose elytra are oval, one half brown and one half white. The pale half has a triangular patch of small chitinous tubercles. The parapodia have a fair number of notosetae, each of which is weakly spinulose with an abruptly tapered tip. The neurosetae are also weakly spinulose and the tip at first appears to be unidentate, but careful examinations show a small, blunt secondary tooth.

Although the colouration of the elytra is reminiscent of *Polynoe erythrotaenia*, the other characters differ and the terminal insertion of the lateral antennae shows that this species should be removed from the genus *Polynoe*. Fresh material is required before its generic position and exact characters can be determined.

Lepidasthenia elegans (Grube)1840

Lepidasthenia affinis Horst 1917, p. 85, pl. 19, fig. 8.
Lepidasthenia elegans. Fauvel 1923, p. 88, fig. 23 *a–g*.

Records: TRA.133(1); SCD.58(1).

Notes: These two specimens from dredgings off the Cape and another that I have seen from the shore of Inhaca Island agree very well with Fauvel's description apart from the minor points noted below. They have rather fewer elytra (23 as against 30–36 for the Mediterranean specimens) and individual elytra are rather larger though they leave the central third of the back bare except at the anterior end. Each elytron is speckled with dark pigment except for a white spot which marks the area of attachment. The prostomium, eyes, antennae and dorsal cirri are identical. As in the Mediterranean form the notopodia usually lack setae but careful search revealed that a few feet have a single minute notoseta with poorly marked serrations. The neurosetae are variable both along the length of the body and within a single fascicle. The first few feet have 2–3 slender superior setae with long, coarsely spinulose blades. The remaining setae of an anterior foot are stouter with short spinulose blades and strongly bidentate ends though the secondary tooth is markedly smaller than the terminal one. Further back along the body the slender superior setae are lacking and a giant brown superior seta appears. Moreover the secondary tooth is reduced and may be completely lacking so that the giant seta becomes unidentate, with only a few rows of rather worn spinules.

L. elegans has already been recorded from Zanzibar by Potts (1910) but he makes no mention of the slender superior setae of anterior feet. Horst's description of *L. affinis* from Lombok in the East Indies leaves no doubt that

his specimen is conspecific with mine though it had 40 pairs of elytra. He separates *L. affinis* from *L. elegans* as described by Potts on the relative size of the elytra and minor differences in the disposition of the setae. I feel, however, that Potts's description was too brief and that further specimens have shown these characters are too variable to warrant specific distinction.

Lepidasthenia brunnea n. sp.

(Fig. 3 *a–d*)

Records: FAL.352(2).

Description: The type material consists of two broken specimens, the largest anterior fragment measuring 40 mm. by 5 mm. (including parapodia) and having 48 segments. The body is light brown in alcohol with colourless parapodia and the large deciduous elytra are half brown and half transparent.

The prostomium (fig. 3*a*) is bilobed and almost twice as broad as long. The anterior pairs of eyes are larger and wider apart than the posterior pair. The three long smooth antennae are very alike. All arise from short ceratophores on the anterior margin of the prostomium and taper slowly towards the final slender tip. The median, which is a little longer than the laterals is 5–6 times the length of the prostomium and roughly equal in length to the width of the body. The tentacular cirri are both about as long as the lateral antennae and each arises from a stout base with a projecting aciculum. The palps are stout and equal the length of the tentacles.

The body is long and flattened, brown dorsally and pale ventrally. The elytra are large and overlap to cover the back They are inserted as usual on segments, 2, 4, 5, 7, 9 . . . and alternating segments anteriorly but on every third further back and, since the body is broken, it is not possible to say how many there were, but as the anterior fragment has 21 elytra scars there must have been many more on the complete worm.

Each elytron is oval in shape, very thin and quite smooth. The anterior half which lies under the preceding elytron is colourless but the exposed posterior half is pale brown. The dorsal cirri arise from short broad cirrophores and extend outwards well past the tips of the setae. Each one is quite smooth and colourless, rounded in section and tapers evenly to a slender tip. The first few are considerably longer than those from the middle of the body.

The notopodia (fig. 3*b*) are reduced to tiny pointed lobes lying on the dorsal surfaces of the neuropodia. Each contains an aciculum but there are no notosetae. The neuropodia are stout fingerlike organs projecting from the sides of the body and posterior ones are longer than the body is broad. Each has a long pointed presetal lip, a rather shorter postsetal lip and between these two issues a fan of long setae. The ventral cirrus is short and between it and the body the ventral surface of the parapodium bears a single row of about 8 elongate papillae.

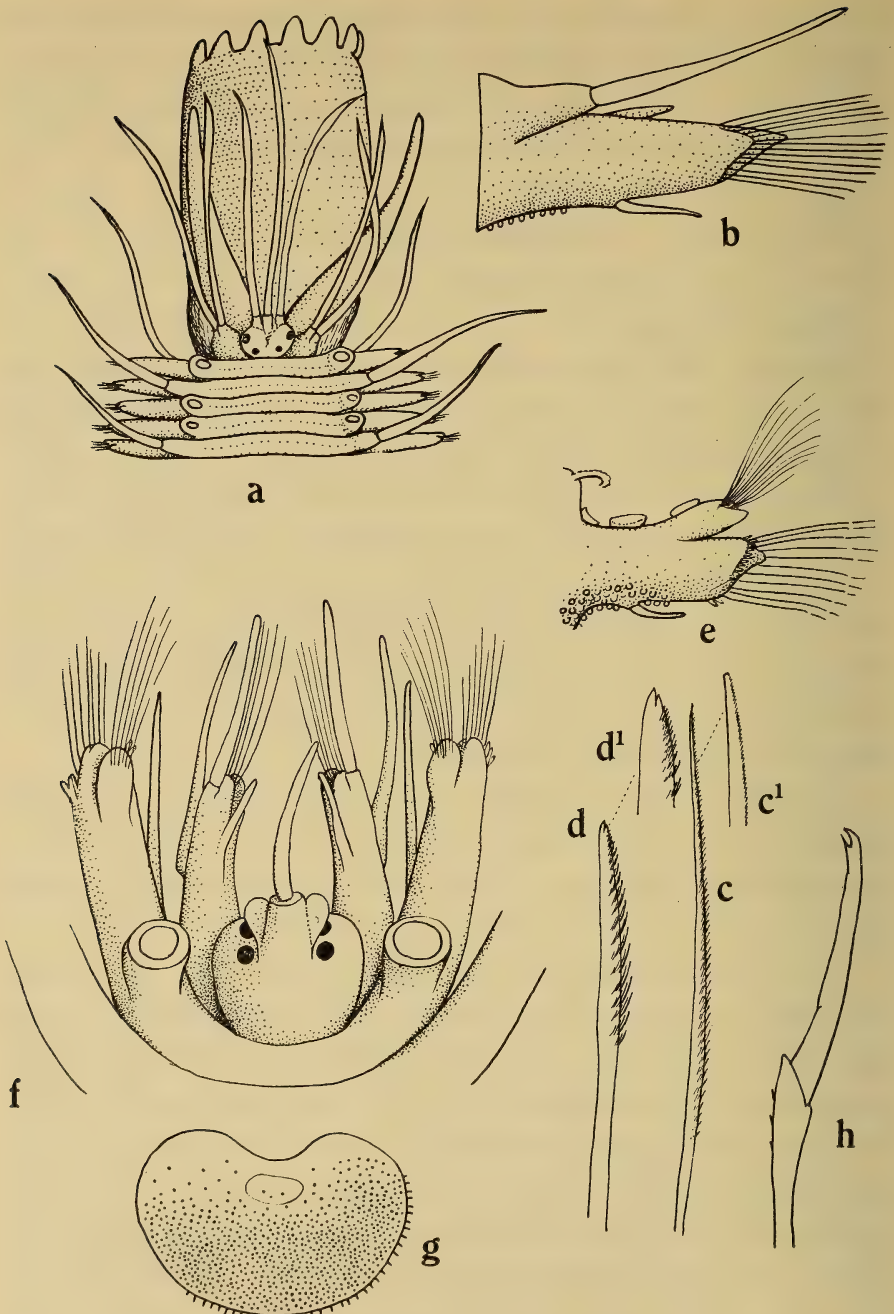

FIG. 3. *Lepidasthenia brunnea: a* head; *b* posterior view of parapodium; *c*, c^1 superior neuroseta; *d*, d^1 inferior neuroseta.

Sthenelais papillosa: e posterior view of parapodium; *f* head; *g* elytron; *h* neuroseta.

The neurosetae are characterized by the possession of a superior group of setae (fig. 3*c*) with long blades feathered to their fine hairlike tips which end in minute knobs. A few such setae are present in the anterior feet of many species of the genus *Lepidasthenia* but in this species there are many of them in all feet. The inferior setae (fig. 3*d*) are stouter and have much shorter feathered blades which end in bidentate tips. The secondary tooth is half the size of the terminal one but the feathering comes so close to the end that the secondary tooth may be obscured.

This species differs from *L. elegans* in many respects particularly the colouration, the persistence of fine unidentate setae, the lack of a giant seta and the possession of papillae on the base of the neuropodia. In *L. maculata* Potts, which has papillae on the ventral surface of the parapodium, the fine superior setae are very few and only present in anterior segments and the bidentate setae have very few rows of serrations. *L. berkeleyae* Pettibone (1948) is close but the antennae are shorter, there are fewer fine neurosetae and there are no ventral papillae on the neuropodia.

Lepidasthenia sp.

Records: AFR.790(1).

Notes: An anterior fragment of 32 segments measuring 18 mm. was obtained. It is completely colourless with rather glassy setae, and large, delicate translucent elytra.

The general shape of the body, the head and the appendages is similar to *L. brunnea* but there are two important differences. There are no papillae on the ventral surface of the neuropodia and there are no bidentate neurosetae, only fine setae with long blades feathered to their slender hairlike tips.

Since the fragment consists of only 32 segments with 15 pairs of elytra it is impossible to say how many elytra are present in the entire worm. Further, the bidentate type of neurosetae might appear in posterior feet. For these reasons this is not described as a new species.

Euphione elisabethae (McIntosh 1885)

Euphione elisabethae McIntosh 1885, p. 62, pl. 9, fig. 3; pl. 17, fig. 7; pl. 18, fig. 10; pl. 8A, figs. 3–6.

Records: AFR.691(1), 707(1), 791(1), 1529(1), TRA.21(1).

Hololepida australis Monro 1930

Hololepida australis Monro 1930, p. 93, fig. 9 *a–h*.

Records: AFR.707(1).

Notes: The present material has been compared with Monro's type in the British Museum and found to be conspecific. The nuchal flap is triangular. The elytra which are fragile and deciduous bear numerous three-pronged

tubercles exactly as described by Monro. They are reminiscent of the tubercles of *Halosydna* and indeed the genus *Hololepida* is closely related to *Halosydna*. The notosetae are not smooth as stated by Monro for under high magnification they show steplike serrations. The superior neurosetae are as shown by Monro but his intermediate type was not found. The inferior neurosetae are bidentate and the secondary tooth, though finer than the terminal one, is almost as long so that the ends of these setae seem to be split.

This is a new record for South Africa.

Polyeunoa laevis McIntosh 1885

Enipio rhombigera Ehlers 1908, p. 47, pl. 4, figs. 1–12.
Polynoe agnae McIntosh 1925, p. 21, pl. 2, figs. 3 and 4.
Hemilepidia erythrotaenia (non Schmarda) McIntosh 1925, p. 26, pl. 2, figs. 9 and 10.

Records: AFR.789(1), 831(1); TRA.48(1); WCD.3(4).

Notes: The present specimens, like those described by Monro (1936), have elytra which are smooth apart from a triangular patch of minute hemispherical tubercles near the point of attachment. These papillae are absent from McIntosh's type. The superior neurosetae have markedly stronger spinules than the inferior ones. Small specimens of 18 and 20 mm. have a minute but distinct secondary tooth on the neurosetae but large specimens are usually unidentate though vestiges of the secondary tooth may occasionally be found among the inferior setae.

The identity of Ehlers' *Enipio rhombigera* with *P. laevis* has long been recognized. A recent examination of the type of *Polynoe agnae* (also called *Eunoa agnae* by McIntosh 1925) which is now in the British Museum (registered number 1924:7:21–27) shows that this is also *P. laevis*. The specimen recorded by McIntosh (1925) as *Hemilepidia erythrotaenia* is in a very poor condition but re-examination again shows that it is also *P. laevis*.

Subfamily Sigalioninae

Pholoe minuta Fabricius var. *inornata* Johnston 1865

Pholoe minuta var. *inornata*. Fauvel 1923, p. 120, fig. 44 *a–h*.
?*Pholoe minuta* Ehlers 1913, p. 450. Augener 1918, p. 118.

Records: SB.189(1); FAL.22(1), 152(1), 314(1); SCD.26(1).

Notes: The median antenna has a stout base and a slender tip, the whole equalling the length of the prostomium. The eyes are coalescent. The elytra are rounded to reniform and the margins carry soft papillae which are not annulated. The papillae on the neuropodia are not obvious and the shaft-heads of the neurosetae are lightly serrated. Ehlers (1913) recorded *P. minuta* from False Bay and Augener (1918) who recorded the variety *inornata* from South West Africa has discussed its distribution and affinities, but the distinctions between the various species and varieties given by Fauvel (1923) are not very convincing.

Sthenelais boa (Johnston) 1833

Sthenelais boa. Fauvel 1923, p. 110, fig. 41 *a–l*. Day 1953, p. 406.

Records: LB.299(3); TRA.88(1), 133(1).

Sthenelais limicola (Ehlers) 1864.

Sthlenelais limicola. Fauvel 1923, p. 113, fig. 42 *a–g*.

Records: AFR.736(1); ?TRA.106D(1); FAL.184(3), 206(1), 228(1), 237(1), 238(3), 242(1), 341(1), 352(7), 375(3), 376(4), 378(1); ?MB.79(1); SCD.109(1).

Sthenelais papillosa n. sp.

(Fig. 3*e–j*)

Records: FAL.223(1), 334(1), 341(1).

Diagnosis: A species with specked elytra lacking simple serrate neurosetae and having a papillose ventral surface.

Description: The type material consists of two fragmentary specimens dredged in False Bay. The larger specimen (FAL.223) is an anterior end of 40 segments and the smaller one FAL.334 is in three fragments but possesses elytra. It is estimated that the larger specimen might have measured 40 mm. by 3 mm. when complete.

The prostomium (fig. 3*f*) is ovoid, a little longer than broad, with a stout median ceratophore and two pairs of well-marked eyes. The 'ctenidia' on the ceratophore are rather small and the ceratostyle is slightly longer than the prostomium. The tentacular segment has a flattened presetal lip, a bundle of simple notosetae, a short dorsal cirriform appendage (which, according to Fauvel (1923), corresponds to the lateral antenna) a large dorsal cirrus (or ? postsetal lobe) and a long ventral cirrus arising from the base of the foot. The body is elongate and the whole of the ventral surface including the midventral line and the bases of the parapodia is densely covered with small spherical papillae. Anterior elytra are not known but those from the middle of the body (fig. 3*g*) are reniform without any external notch and the margins bear minute unicellular papillae which are elongate laterally and spherical posteriorly. The surface of each elytron is speckled with brown and studded with tiny, transparent, very lightly chitinized and flattened tubercles or cushion-like papillae.

The notopodium (fig. 3*e*) has about 6 short stylodes and the usual bundle of long notosetae. The neuropodium has 2–3 short stylodes at the apex of the acicular lobe and a low presetal lip edged with about 8 elongate papillae. The ventral margin of the parapodium as mentioned above, bears numerous spherical papillae and a single short ventral cirrus.

The notosetae are typical. The neurosetae (fig. 3*j*) lack superior simple serrate setae and the compound setae are all very similar. The shafts are stout,

the triangular shaft-heads are lightly serrate and most of the blades are long and simple though some of the short inferior ones have 2–3 poorly marked articulations.

S. papillosa has been compared with the types of *S. zeylanica* Willey and also *S. variabilis*, *S. orientalis* and S. *foliosa* Potts (1910) all of which have a papillose ventral surface but in each case other characters differed. *S. papillosa* also approaches *S. minor* in the lack of simple serrate neurosetae but the latter may be distinguished by the possession of elongate and pluriarticulate neurosetae and the lack of papillae on the ventral surface.

Sigalion squamatum Delle Chiaje 1841

Sigalion squamatum. Fauvel 1923, p. 104, fig. 39 *m–o.*

Records: FAL.243(1), 357(1).

Notes: Two anterior fragments were obtained belonging to large specimens probably exceeding 100 mm. Four tiny well-separated eyes are just visible through the skin of the prostomium. The dorsal cirrus of the first setiger is $\frac{1}{2}$–$\frac{2}{3}$ the length of the ventral cirrus but dorsal cirri are absent from the second and subsequent setigers. A clavate presetal papilla appears at the end of the notopodium from the 5th foot onwards. Each elytron is rectangular and the external margin bears simple papillae on its upper surface and bipinnately branched papillae along its external margin, each of these having 7–10 pairs of branches. Rudimentary cirriform gills appear on the medial and lateral margins of the elytrophore of the second or third foot and by the 6th foot the gills are well developed. Later the medial gill decreases in size but the lateral one remains large. The anterior face of the notopodium of each foot has a patch of conical tubercles near its base.

The notosetae are numerous and minutely serrate. The neurosetae are of 5 types: (*a*) about 6 simple bipectinate setae in the superior group above the aciculum. (*b*) About 2 compound setae with coarsely serrate shafts and tapered, pluriarticulate blades. (*c*) About 4 compound setae with swollen, closely serrate shaft-heads and pluriarticulate blades. (*d*) About 6 compound falcigerous setae with fine serrations on the shaft-heads and simple bidentate blades. (*e*) Very numerous inferior compound setae with very lightly serrate shaft-heads and long pluriarticulate blades. All the various types of compound setae of this and all other species of *Sigalion* which have been examined have bidentate tips. Statements to the contrary are probably due to the examination of broken-tipped setae.

This South African material has been compared with specimens of *S. squamatum* from Naples, which is the type locality. The European material shows that the development of the superior 'stylode' (=presetal lobe) of the neuropodium is variable and not of much value in separating *S. squamatum* from *S. mathildae*. Again the pennate marginal papillae on the elytra are not normally as widely different as figures 39 *c* and *m* in Fauvel (1923) would

suggest. I agree with Fauvel that the main difference lies in the setae, though the tubercles on the face of the notopodium are more poorly developed in *S. mathildae*. Incidentally these same tubercles are exceedingly long and occasionally branched in *S. buskii* McIntosh (1885) and suggest that this is a valid species which lacks falcigers with simple bidentate blades. It is also to be noted that Fauvel makes no reference to the medial gill on the elytrophores, and this character was not checked on the Naples material.

Sigalion capense n. sp.

(Fig. 4 *a–f*)

Records: FAL.237(1), 375(1); MB.4(1).

Description: FAL.237 an ovigerous female, is selected as the type. It is 16 mm. long by 2 mm. wide and is broken at the 60th segment. It is quite white in alcohol.

The prostomium (fig. 4*a*) is almost oblong, a little longer than wide and somewhat rounded posteriorly. The two pairs of small eyes are visible through the skin about the middle of the prostomium. The anterior and posterior pair are close together on either side. The antennae are small cylindrical papillae arising from the prostomium at its junction with the forwardly projecting tentacular segment which bears two pairs of subequal tentacular cirri. The palps are long and slender. The ventral cirrus of the second foot is about the same length as the tentacular cirri. A single cirriform branchia arises from the lateral side of the elytrophore of the 4th and all succeeding segments and in anterior segments there is also a small branchia (or ctnidium) on the medial side of each elytrophore.

The posterior elytrophores are swollen with developing eggs. The elytra themselves (fig. 4*c*) are rounded to rectangular with smooth surfaces and bear 10–12 bipinnate papillae on the external margin; each of these has 4–8 pairs of branches (fig. $4c^1$).

The notopodium (fig. 4*b*) is swollen distally with a single large presetal papilla (stylode) at its end and three glandular cushions on its superior margin. It bears a bundle of long slender setae with hairlike tips. The stouter ones are serrate on the inferior margin.

The neuropodium is obliquely truncate with a bluntly conical acicular lobe, a vestigial presetal lip, a well-developed, trangular postsetal lip and a long tapered ventral cirrus. There are 4 types of neurosetae. The supra-acicular neurosetae include: (*a*) 3–6 simple bipinnate setae (fig. 4*d*); (*b*) 4 fairly stout compound setae (fig. 4*f*) with long pluriarticulate blades and serrated shaft-heads; (*c*) about 10 fairly stout compound setae with long pluriarticulate blades and smooth shaft-heads (fig. 4*e*) The infra-acicular setae include: (*d*) about 4 setae similar to group (*c*) and (*e*) very numerous fine compound setae with long pluriarticulate blades and smooth shaft-heads. It is emphasized that

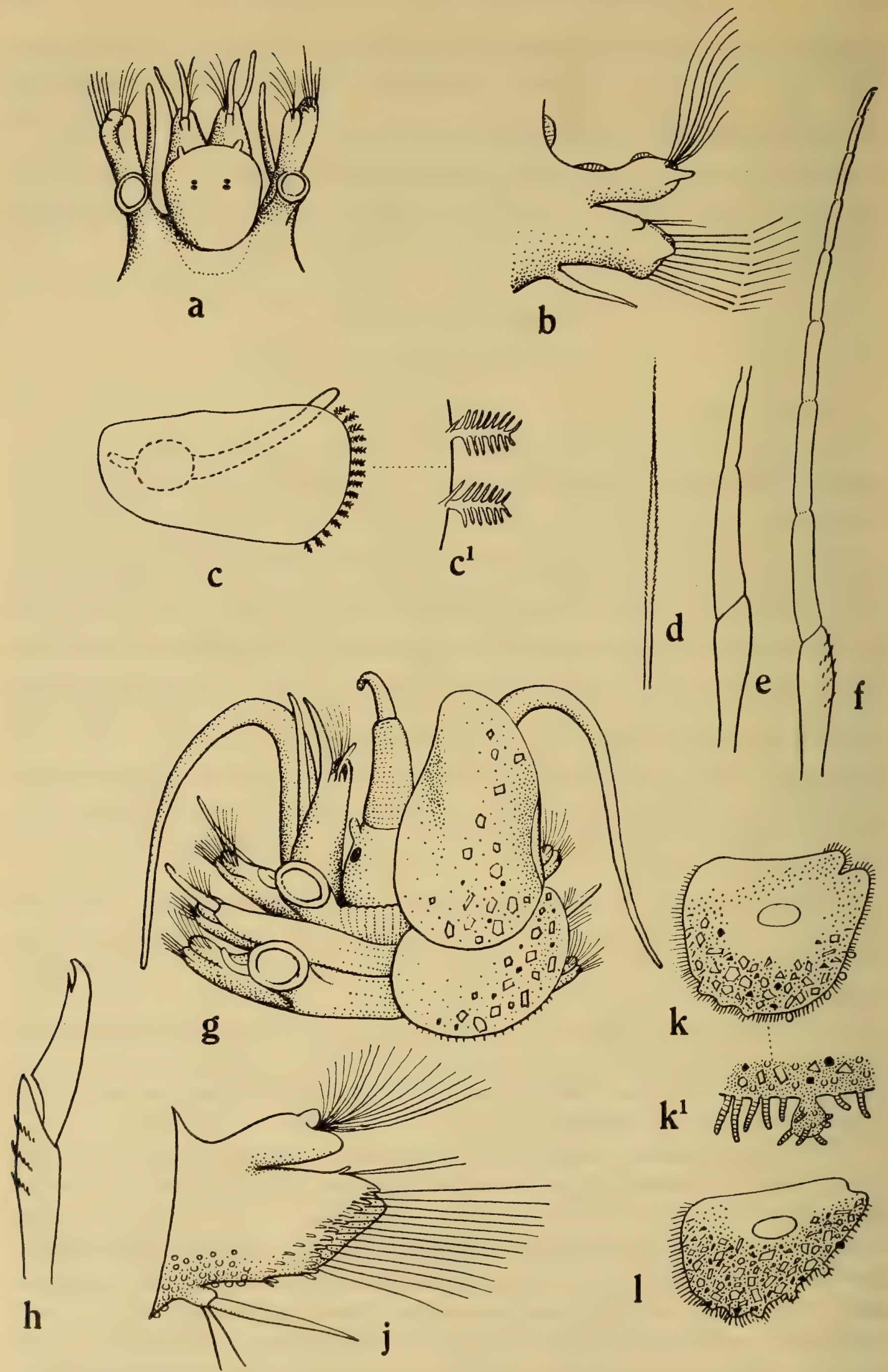

FIG. 4. *Sigalion capense: a* head; *b* parapodium; *c*, *c*[1] elytron and details of marginal papillae; *d* simple serrate neuroseta; *e* smooth-shafted neuroseta; *f* serrate-shafted neuroseta.

Psammolyce articulata: g head; *h* neuroseta; *j* parapodium; *k*, *k*[1] 6th elytron and details of margin; *l* posterior elytron.

all compound setae have long pluriarticulate blades with minutely bidentate tips.

S. capense may be distinguished from *S. squamatum* and *S. mathildae* by the lack of neuropodial setae with simple blades. In this and other respects it resembles *S. ovigerum* Monro (1924) but the latter carries eggs in its swollen elytra and has supra-acicular neurosetae with excavated shaft-heads as figured by Monro (1936) fig. 12*d*.

Psammolyce articulata n. sp.

(Fig. 4 *g–l*)

Records: FAL.117(1), 211(2), 214(1).

Description: Four broken specimens were obtained and specimen FAL.117 which is in two fragments totalling 50 mm. by 4 mm. for 100 segments was selected as the holotype. It is sandy brown in alcohol with darker setae. The elytra and the uncovered part of the back between them is covered with sand-grains and foraminiferan shells and the ventral surface is completely covered with small rounded tubercles.

The head (fig. 4*g*) is protected between, but not fused to, the forwardly directed first pair of feet which bear the tentacular cirri. The prostomium itself is as broad as long and bears two pairs of large eyes and three antennae. The first pair of eyes are anterior and ventral and concealed beneath the large ceratophore of the median antenna. The posterior pair of eyes is on the sides of the prostomium immediately behind the short stumpy lateral antennae which are quite separate from the tentacular segment. The median antenna is borne on a large ceratophore which curves down like an elephant's trunk.

The first setiger or tentacular segment has well-developed dorsal and ventral rami and two bundles of setae. The notopodium has a rather short dorsal tentacular cirrus and a stumpy setigerous lobe. The neuropodium has a presetal bract, a bundle of neurosetae and a large cirriform postsetal lobe below which is the long tapering ventral tentacular cirrus. The second segment bears the first pair of elytra, a short cirriform gill, two setigerous lobes and a long ventral cirrus. There is no dorsal cirrus. The third segment bears a long stout elytrophore extending almost to the end of the neuropodium and a shorter cirrus.

The elytra (figs. 4 *k–l*) vary along the length of the body but all of them are covered with sand grains. The anterior pair are pear-shaped and extend forward over the head. The margins appear smooth and there are certainly no incisions or large projections. The second pair are reniform. The margins bear minute papillae and the surface is studded with microscopic tubercles. The next few elytra are more rounded (fig. 4*k*) straight in front and with two short lobes on the medial margin and small pear-shaped lappets posteriorly. The surfaces are covered with microscopic tubercles and the papillae are better developed, both on the surface and the margins. *All of them are clearly jointed.*

Further back the two antero-medial lobes tend to disappear (fig. 4*l*) and the 4–5 posterior lappets become irregular. Most of the elytra are roughly triangular and fairly small so that the middle third of the back is uncovered.

The feet (fig. 4*j*) show little change from the 4th onward. The notopodium is well developed. The neuropodium is obliquely truncated with a presetal row of elongate papillae and tufts elsewhere. The lower surface is covered by the rounded tubercles which extend on to the parapodia from the ventral surface. The ventral cirrus is long and tapered and 2–3 very long and slender papillae arise from its base.

The notosetae are numerous and very fine. Each is minutely serrated to its hairlike tip. The neurosetae (fig. 4*h*) are all compound and falcigerous. Those of the second setiger have densely serrated shafts but in later feet the serrations are reduced to 3–5 rows on the shaft-head. The blades are all bidentate but never pluriarticulate.

In his diagnosis of the genus *Psammolyce*, Fauvel (1923) states that the lateral antennae are fused to the first setiger or possibly absent in *P. inclusa*. Monro (1936) makes the same remark. In the present species as stated, the lateral antennae arise from the prostomium which is quite separate from the first setiger. *P. articulata* is also characterized by the possession of jointed papillae on the elytra. Faint indications of jointing were seen in the papillae of *P. semiglabra* Monro (1936), the type of which was examined, but the two species differ in many characters. Possibly *P. articulata* comes closest to *P. zeylanica* Willey (1905) in the shape of the elytra but the latter again has the lateral antennae fused to the first setiger.

Thalenessa oculata (Peters) 1854

Euthalenessa dendrolepis (Clap.) Fauvel 1923, p. 114, fig. 42 *h–o*.
Euthalenessa oculata Day 1953, p. 407.

Records: SB.207(1); TB.301(1), 304(4); FB.312(1), 321(1); FAL.233(1), 238(1), 349(3); SCD.105(2 juveniles).

Family *CHRYSOPETALIDAE*

Bhawania goodei Webster 1884

Bhawania goodei. Augener 1918, p. 98, pl. 2, figs. 1–2, text-fig. 1. Day 1953, p. 407.

Records: False Bay—21 records on rocky or shelly bottoms between 0 and 36 metres. MB.13(1), 53(1), 56(1), 77(1), 85(1), 86(1); LIZ.9(1), 27(1), 33(1); SCD.58(1), 89(1).

Paleanotus chrysolepsis Schmarda 1861

Paleanotus chrysolepis Schmarda 1861, p. 163, pl. 37, figs. 326–9. Ehlers 1913, p. 450. Day 1957, p. 66.

Records: False Bay—15 records on rock or shelly bottoms between 0 and 40 metres.

Family *AMPHINOMIDAE*

Chloeia inermis Quatrefages 1865

Chloeia gilchristi McIntosh 1925, p. 15, pl. 1, figs. 7–8. Day 1934, p. 27, fig. 4 *a–b*.
Chloeia inermis. Monro 1936, p. 80.

Records: AFR.801(1); TRA.20(1).

Notes: The specimens were recovered from the stomachs of fish and are rather soft but they still retain rather vague purplish markings along the middorsal line and the dorsal cirri are purple. Monro states that the gills begin on setiger 5 but here they begin on setiger 4. The setae agree perfectly with Monro's description. A spur is virtually absent from most of the setae though a minute one can be seen on some of the ventral ones. All but a few of the harpoon setae are smooth.

Euphrosyne capensis Kinberg 1857

Euphrosyne capensis. McIntosh 1885, p. 1, pl. 2, fig. 5, pl. 1A, figs. 1–3. Day 1953, p. 408.

Records: LAM.8(1), 15(1), 31(8), 35(2), 47(1), 51(3), 57(1), 59(3), 63(1); TB.305(1), 323(1); False Bay—17 records between 0 and 42 metres on rock or broken shell; MB.16(2), 49(2), 67(1), 77(1), 78(2); LIZ.18(1)

Euphrosyne myrtosa Savigny 1818

Euphrosyne myrtosa. Gravier 1901, p. 254, pl. 10, figs. 147–9.

Records: TRA.132(1), 135(1); SCD.40(1).

Notes: Ehlers (1913) who previously recorded this well-known species from the Cape was doubtful whether it was distinct from *E. capensis*. Many specimens of varying size were therefore examined and it appears that there is a constant difference in the branchiae. In *E. myrtosa* there are 6–8 branchial trunks and the tips of the branches are blunt and not expanded. In *E. capensis* there are 10–11 branchial trunks and the tips of the branches are swollen and pointed rather like acorns.

Eurythoe chilensis Kinberg 1857

Pareurythoe chilensis Hartman 1948, p. 45, pl. 5, fig. 11.
Eurythoe chilensis Kinberg 1857, p. 13. Monro 1930, p. 28, fig. 1 *a–e*.

Records: FAL.29(1).

Notes: The single specimen is 20 mm. long. The caruncle is attached to the dorsum as far back as the second setiger, but a free posterior projection extends back to the fourth setiger. This species is easily distinguished from the tropical *E. complanata* which extends down the Natal coast by its smaller size and the fact that all the spurred setae are lightly serrated in *E. chilensis* and smooth in *E. complanata*. This is a new record for South Africa.

Family *PHYLLODOCIDAE*

Phyllodoce (*Anaitides*) *madeirensis* Langerhans 1879

Phyllodoce (*Anaitides*) *africana* Augener 1918, p. 171, pl. 2, fig. 25; pl. 3, figs. 49–51; text-fig. 11 (*partim*).
Phyllodoce (*Anaitides*) *madeirensis*. Fauvel 1923, p. 150, fig. 53 *a–d*.
Phyllodoce patagonica (non Kinberg) Monro 1930, p. 72 (partim).

Records: AFR.707(1); TRA.56(1), 133(1); FB.316(1); FAL.241(1), 373(1).

Notes: By the kindness of the Director of the Hamburg Museum I was able to examine Augener's specimens of *P. africana* from Goree (number V.1986). There are two specimens, one with the proboscis extruded and one with the proboscis retracted; both were quite pale in alcohol, the pigmentation to which Augener refers having faded. The former specimen with the extruded proboscis is clearly on *Anaitides* with 6 lumpy ridges on the distal part of the proboscis and 6 lateral rows each with 8–10 compressed papillae basally. The prostomium is cordate with 4 normal antennae, a pair of large eyes and an occipital papilla in the posterior notch. The first tentacular segment is invisible dorsally but the second and third are distinct. There is no parapodium or setae on the third tentacular segment, the formula being $1 + 0\frac{1}{1} + 0\frac{1}{N}$. Anterior dorsal cirri are broadly lanceolate but later ones are obliquely truncate near the tip and rhomboidal. The ventral cirri are pointed and longer than the setigerous lobes. This specimen seems to me to be a typical *P. madeirensis*.

The second specimen with the retracted proboscis was dissected and its proboscis proved to be irregularly covered with large pointed papillae except at the base where the dorsal wall was bare. The prostomium is elongate and deeply incised posteriorly forming a pair of lateral lobes which extend back to segment 2. No occipital papilla was seen. The first tentacular segment is not visible dorsally, the second is partly visible between the posterior lobes of the prostomium but the third segment is fully visible. A small setigerous lobe bearing 2–3 setae is present on tentacular segment 3, the formula thus being $1 + 0\frac{1}{1} + S\frac{1}{N}$. Anterior dorsal cirri are broadly lanceolate, almost cordate, but later ones are longer and more asymmetrical with broad cirrophores. The ventral cirri are pointed and about as long as the setigerous lobes. This specimen does not belong to the sub-genus *Anaitides* and should be named *Phyllodoce* (*Phyllodoce*) *africana*.

I have also examined the specimen reported by Monro (1930) from Simonstown under the name of *P. patagonica*. It is quite clearly *P. madeirensis* and may be distinguished from *P. patagonica* by the absence of setae on tentacular segment 3.

It may also be mentioned that some of my own specimens recorded above from deeper dredgings are blotched with dark pigment and some of the dorsal cirri are black and others white. Otherwise they are indistinguishable from the normal green variety of *P. madeirensis*.

Phyllodoce sp.

Records: TRA.133(1).

Notes: Specimen TRA.133.L certainly belongs to a species which has not been recorded from South Africa before but the preservation is not too good and its exact determination is doubtful in consequence.

The body is brownish blotched with darker pigment. The proboscis appears to be diffusely papillose. The prostomium is cordate and there is a small occipital button in the posterior notch. The first tentacular segment is fused to the prostomium but the second and third are distinct. The tentacular cirri are unusual for they are stout, sausage-shaped and constricted basally. The tentacular formula is $1 + 0\frac{1}{1} + S\frac{1}{1}$. The dorsal cirri are ovoid and swollen and the oval ventral cirri are a little larger than the blunt setigerous lobes. The setae have oval shaft-heads and short blades.

Phyllodoce macrophthalma Schmarda 1861

Phyllodoce macrophthalma. Fauvel 1923, p. 146, fig. 51 *f–g*.

Records: MB.20(1).

Notes: The single 12 mm. specimen is referred to *P. macrophthalma* with some hesitation. The body is slender and dark green. The prostomium is cordate with a very small posterior notch and the presence of an occipital button is doubtful. The proboscis on dissection seems to be lightly papillose. The first tentacular segment is fused to the prostomium but the second and third are distinct. All the tentacular cirri are well developed and cylindrical, the formula being: $1 + S\frac{1}{1} + S\frac{1}{1}$.

The dorsal cirri are cordate, possibly a little longer than broad and the ventral cirri are ovoid. The setigerous lobe has a notched presetal lip and bears numerous setae with oval shaft-heads striated distally and fairly short blades.

Schmarda (1861) stated that the dorsal cirri are rhomboidal but both Ehlers (1913) who recorded this species from Simonstown and Fauvel (1923) follow Saint-Joseph (1888) and describe cordate dorsal cirri. I have not seen the latter paper.

Phyllodoce (*Anaitis*) *capensis* n. sp.

(Fig. 5 *a–c*)

Records: FAL.316(1); TRA.133(1).

Description: Specimen FAL.316 which measures 35 mm. by 1·5 mm. for about 100 segments was chosen as the holotype. It is depressed and tapered posteriorly and is creamy white in alcohol.

The prostomium (fig. 5*a*) is broadly rounded anteriorly and produced posteriorly. The frontal antennae are well developed, the eyes are large and there is a small occipital button. The first and second tentacular segments are fused and form a sort of transparent shield which grows forwards over the sides of the prostomium to cover part of the eyes but the occipital button in the mid-dorsal line is not covered. The third tentacular segment is distinct. All the tentacular cirri are cylindrical and tapered but T_1 and V_2 are shorter than T_2 and T_3. There is a small setigerous lobe on the third tentacular segment so that the tentacular formula is: $1 + 0\frac{1}{1} + S\frac{1}{N}$.

The proboscis was not extruded and dissection was not entirely successful. The distal part definitely has 6 longitudinal rows of large soft papillae or rugosities but the oral end is indistinct. There were no obvious rows of papillae and it may be smooth.

The papapodia and dorsal cirri (fig. 5*b*) are essentially similar throughout the length of the body. The dorsal cirri are fairly large and rounded to broadly cordate but they do not cover the back. The ventral cirrus is oval and larger than the setigerous lobe which has a notched presetal lip and bears about 12 fine heterogomph spinigers. The shaft-head (fig. 5*c*) is asymmetrical with a large curved tooth accompanied by 3–4 smaller denticles on one side and a smaller tooth on the other side. The finely serrated blade is long, fairly broad basally and tapers gently towards the tip.

This South African species is obviously related to *P.* (*A.*) *kosteriensis* Malmgren from northern Europe but differs in several respects. The shield formed by the fusion of T_1 and T_2 is better developed, the proboscis is different, the dorsal cirri are proportionately longer and the setae have slightly different shaft-heads. *P.* (*A.*) *wahlbergi* Malmgren from the Arctic is, according to Bergström (1914) a much broader worm with a single blunt tooth on the shafthead of the seta.

Phyllodoce castanea Marenzeller 1879

Genetyllis castanea Bergström 1914, p. 158, pl. 3, fig. 4, text-fig. 53.
Phyllodoce rubiginosa Augener 1918, p. 168.

Records: SB.120(1); FB.302(2), 307(3); FAL.128(1), 266(1); MB.23(1).

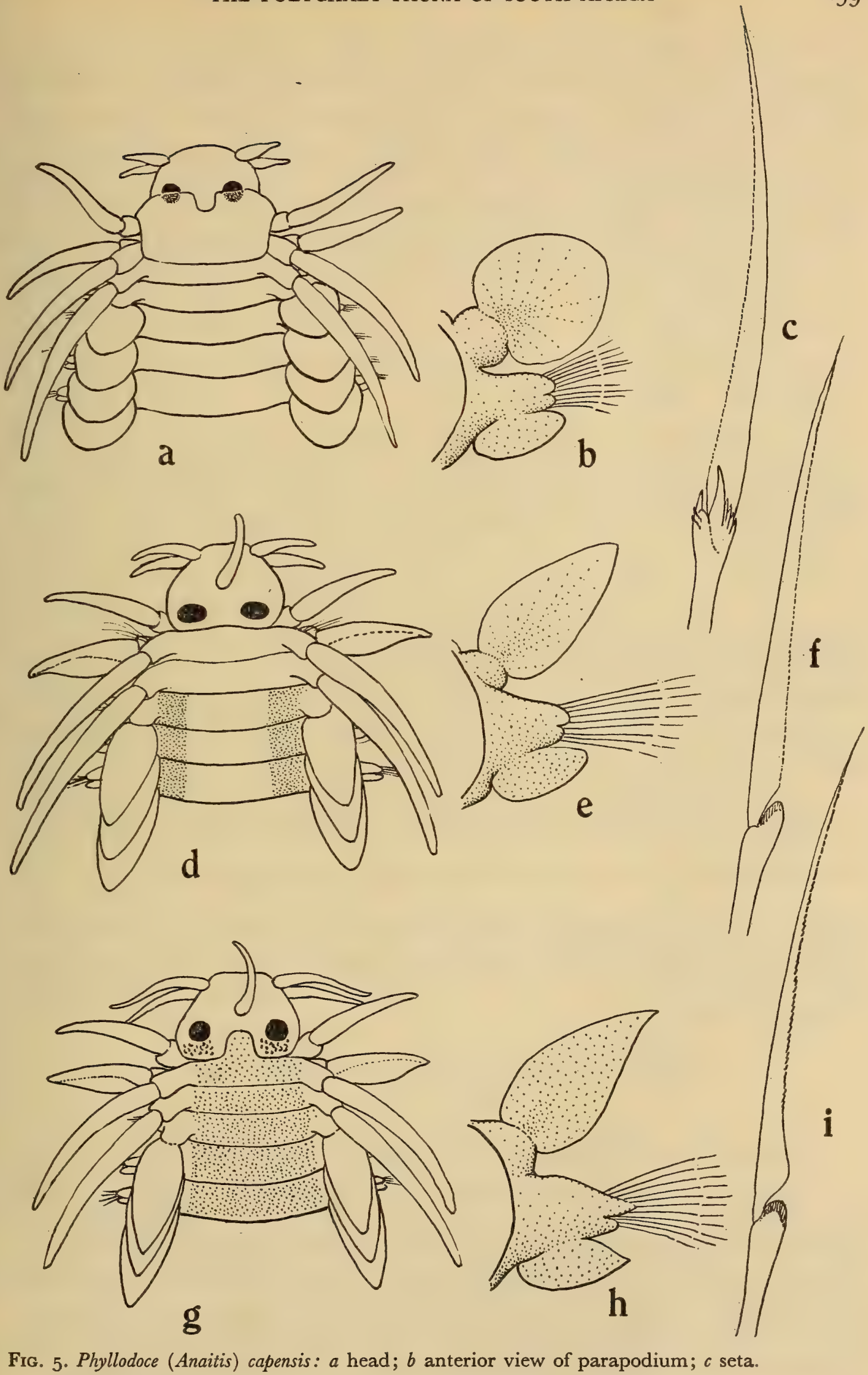

FIG. 5. *Phyllodoce* (*Anaitis*) *capensis*: *a* head; *b* anterior view of parapodium; *c* seta.
Eulalia bilineata: *d* head; *e* anterior view of parapodium; *f* seta.
Eulalia macroceros: *g* head; *h* anterior view of parapodium; *i* seta.

Notes: The Director of the Hamburg Museum very kindly sent me the specimen V.8731 recorded by Augener 1918 from Swakopmund under the name of *Ph. rubiginosa*. The proboscis was retracted but when dissected proved to be very long and covered with irregularly arranged conical papillae. The whole specimen is rusty red all over with an ovoid prostomium not notched posteriorly and fused to tentacular segment 1. The antennae are very small. All the tentacles are short, tapered and rounded. Tentacular segment 1 is not visible dorsally but 2 and 3 are distinct and bear setigerous lobes with numerous setae the formula being $1 + S\frac{1}{1} + S\frac{1}{N}$. Dorsal cirri are broadly cordate and almost symmetrical. Ventral cirri are ovoid to reniform and extend beyond the rounded setigerous lobes.

P. castanea and *P. rubiginosa* are very alike but the latter is described by Fauvel as having large not small antennae and he figures the dorsal cirri as asymmetrical. Certainly Augener's specimen from Swakopmund is very like mine from the western and southern coasts of the Cape.

Eulalia (*Steggoa*) *capensis* Schmarda 1861

Eulalia capensis Schmarda 1861, p. 86, pl. 29, fig. 231. Willey 1904, p. 259.
Eulalia viridis var. *capensis* McIntosh 1904, p. 34. Day 1953, p. 30.
Eulalia viridis (non Muller) Ehlers 1913, p. 455. Day 1934, p. 30.
Steggoa magalhaensi (non Kinberg) Augener 1931, p. 284.

Records: LAM.18(1), 59(3), 63(1); FB.302(1), 326(1); FAL.23(1), 29(1), 44(2); 69(1), 106(1), 149(1), 245(1), 334(1); TRA.123(1).

Notes: This species although generally similar to *E. viridis* differs in having a more flattened ventral tentacular cirrus on the second tentacular segment and in lacking setae on the same segment so that the formula is $1 + 0\frac{1}{1} + S\frac{1}{N}$. It thus belongs to Bergström's genus *Steggoa* here relegated to a sub-genus. On the other hand I cannot agree with Augener (1931) that it is identical with *Steggoa magalhaesi* Kinberg which has spear-shaped dorsal cirri three times as long as broad.

Eulalia (*Hypoeulalia*) *bilineata* (Johnston) 1840
(Fig. 5 *d–f*)

Records: SB.197(1); FAL.371(1); MB.66(2), 87(2); SCD.40(3).

Description: These South African specimens differ in several important respects from the descriptions given by Bergström (1914), p. 165, text-fig. 57, and Fauvel (1923), p. 162, fig. 58 *a–e*, which themselves differ in minor respects. For this reason a full description is given below. The largest of the 3 specimens from SCD.40 measures 20 mm. by 1 mm. for 155 segments. It is a slender yellowish worm with two dark green stripes along its back just above the parapodia. These colours persist in alcohol.

The prostomium (fig. 5*d*) is rounded in front and almost straight posteriorly. The frontal antennae are well developed and the median antenna arises well in front of the eyes which are relatively large. The proboscis is covered with small conical papillae. The relation between the prostomium and the first tentacular segment is difficult to ascertain. In contracted specimens the two seem to be fused but in expanded specimens the first tentacular segment seems to be reduced dorsally but not actually fused to the prostomium. The second and third tentacular segments are definitely distinct. The three dorsal tentacular cirri are cylindrical and those on the second and third segment are rather long; on the other hand V_2 is short and flattened though not bladelike as in the sub-genus *Sige*. The second and third tentacular segments have setigerous lobes with setae so that the tentacular formula is $1 + S\frac{1}{1} + S\frac{1}{N}$.

The body segments do not change appreciably along the length of the worm. The dorsal cirrus (fig. 5*e*) is bluntly lanceolate in adults but distinctly broader, almost cordate in juveniles. The setigerous lobe is bluntly rounded and, as usual, the presetal lip is deeply notched. The ventral cirrus is ovoid. The 12–16 setae are heterogomph spinigers (fig. 5*f*) with ovate shaft-heads striated distally and lightly serrated blades of normal length.

According to Bergström, *Hypoeulalia bilineata* has the first segment fused to the head, V_2 is cylindrical and the dorsal cirri are ovoid. According to Fauvel (1923) *Eulalia bilineata* has the first segment narrowed but fairly short and the dorsal cirri are stout and oval-obtuse. Judged by these descriptions the most marked difference between South African and European specimens concern the shape of V_2.

This is a new record for South Africa.

Eulalia (*Eumida*) *sanguinea* (Oersted) 1843

Eulalia (*Eumida*) *sanguinea*. Fauvel 1923, p. 166, fig. 59 *f–k*.

Records: LAM.22(1); LB.161(2), 382(1); FB.316(1); FAL.70(3), 376(1); MB.86(1); SCD.9(3), SCD.109(1).

Eulalia (*Pterocirrus*) *macroceros* Grube 1860
(Fig. 5 *g–i*)

non Sige macroceros Bergström 1914, p. 136, text fig. 40.
Eulalia (*Pterocirrus*) *macroceros* Fauvel 1923, p. 167, fig. 60 *d–g* (*partim*).
Eulalia (*Pterocirrus*) ?*macroceros* Day 1953, p. 411.

Records: MB.66(1), 86(1).

Description: The discovery of two further specimens allows me to confirm my previous identification, and to complete the description.

The body is broad and short and dark green in life but brownish in alcohol. The prostomium (fig. 5*g*) is cordate with a large posterior excavation containing a dark cushionlike lobe which may represent the dorsal remnant of the first

tentacular segment. The eyes are large and there are usually pigment granules behind them. The two pairs of frontal antennae are surprisingly long and the dorsal antenna arises slightly in front of the eyes. The proboscis has not been seen everted but on dissection the base proves to be smooth but further along there are large soft rugosities. It is certainly not densely covered with cylindrical papillae as in *Eulalia viridis* or *E. capensis*.

The first tentacular segment is fused to the prostomium and bears a pair of cylindrical tentacular cirri. The second segment is distinct and bears a pair of long cylindrical dorsal tentacular cirri on swollen cirrophores, a pair of flattened, often blade-like ventral cirri but there is neither setigerous lobe nor setae. The third tentacular segment bears a long cylindrical dorsal cirrus, a normal foliaceous ventral cirrus but no setigerous lobe or setae. The tentacular formula is thus $1 + 0\frac{1}{1} + 0\frac{1}{N}$.

The parapodia (fig. 5*h*) are very similar throughout the length of the body. The dorsal cirri are elongate-cordate and pointed, the setigerous lobe has the usual bilobed presetal lip but here the larger superior lobe is pointed and the ventral is best described as orbicular with a pointed end. The setae are very numerous (*c*.40). Each has a very slightly expanded shafthead faintly striate distally (fig. 5*i*) and a blade of normal length which is broad and almost smooth basally and then suddenly narrows and becomes strongly serrated.

As will be seen, the above description does not agree with that given by Bergström (1914) and differs in several respects from that given by Fauvel (1923). In a private communication Dr. K. Banse has informed me that my (1953) description agreed almost exactly with his specimen from Naples, and went on to say that *E. macroceros* from the Mediterranean (type locality Quarnero in the Adriatic) is not synonymous with the boreal species *E.* (*Sige*) *fusigera* Malmgren (1865) (described from Koster-Inseln and Skelderviken in Sweden and Drobnak in Norway).

Bergström's description is based on the Swedish material and should be referred to *E.* (*S.*) *fusigera*. Fauvel presumably had more than one species before him.

Some doubt remains regarding the subgenus to which *E. macroceros* should be referred. It does not fit exactly into any of the numerous genera used by Bergström, and certainly cannot be referred to *Sige* which has setae on the second and third tentacular segments. It is suggested here that it should be referred to Claparède's *Pterocirrus* established for *P. velifera* Claparède (1865) from Naples which according to Grube (1880) is synonymous with *E. macroceros*. If this be accepted *Pterocirrus* should be defined as a subgenus of *Eulalia* with the first tentacular segment fused to the prostomium which has a posterior excavation containing a cushion-like lobe. The second and third tentacular segments are distinct, and tentacular cirrus V_2 is flattened. There are no setae on any of the tentacular segments, formula being: $1 + 0\frac{1}{1} + 0\frac{1}{N}$.

Eulalia (*Sige*) *falsa* n. sp.

(Fig. 6 *a–c*)

Records: FAL.187(2), 338(1); MB.87(1).

Description: The type material consists of the two specimens from FAL.187 dredged in False Bay. One is a regenerating individual 17 mm. long by 1·5 mm. wide with 60 segments and an everted proboscis. It is brownish in alcohol. The other is a juvenile 9 mm. long by 1 mm. wide with 60 segments. A fresh specimen (FAL.338) has a brown dorsum with a paler head and parapodia.

The body is elongate and of the usual proportions. The prostomium (fig. 6*a*) is cordate with a pair of large eyes, subulate frontal antennae and a median antenna which arises between the eyes. The first tentacular segment is fused to the head but there is an area between the posterior lobes of the prostomium which may represent the dorsal remains of this segment, or an anterior projection of segment 2. The second and third tentacular segments are distinct and bear long, dorsal, tentacular cirri. Tentacular cirrus V_2 is flattened and may even be blade-like in juveniles. Both the second and third tentacular segments bear setae but those on the second segment are very few and arise from the ventral cirrophore, there being no separate setigerous lobe on this segment. A small setigerous lobe with numerous setae is present on the third segment and below this is the foliaceous ventral cirrus, the tentacular formula being: $1 + S\frac{1}{1} + S\frac{1}{N}$. The extruded proboscis is faintly hexagonal with 6 low longitudinal ridges. The surface is covered with very small and poorly marked papillae so that on first inspection it appears to be smooth. The opening is encircled by 20 large rounded papillae.

The parapodia of the adult (fig. 6*b*) are very similar throughout. The dorsal cirrus is elongate-cordate with a pointed apex, and in specimen MB.87 there is a dark central spot. The setigerous lobe has a bilobed presetal lip, the superior lobe being large and pointed and the inferior lobe being small and blunt. In the juvenile specimen these characters are more marked and the superior lobe has a very long pointed lobe. The setae (fig. 6*c*) are numerous fine heterogomph spinigers with very slightly expanded shaft-heads bearing about 4 small denticles at the distal end. The blades are smoothly tapered and finely serrated.

This species is rather similar to Bergström's description of *Sige macroceros* which, as shown above, really refers to *E.* (*S.*) *fusigera*. However there are differences in the shape of the prostomium, the nature of the proboscis, the shape of the cirri and the structure of the setae. Later work may show that this South African material is conspecific with *E.* (*S.*) *fusigera* from northern Europe, but to avoid further confusion in the synonymy it is as well to keep them separate at present.

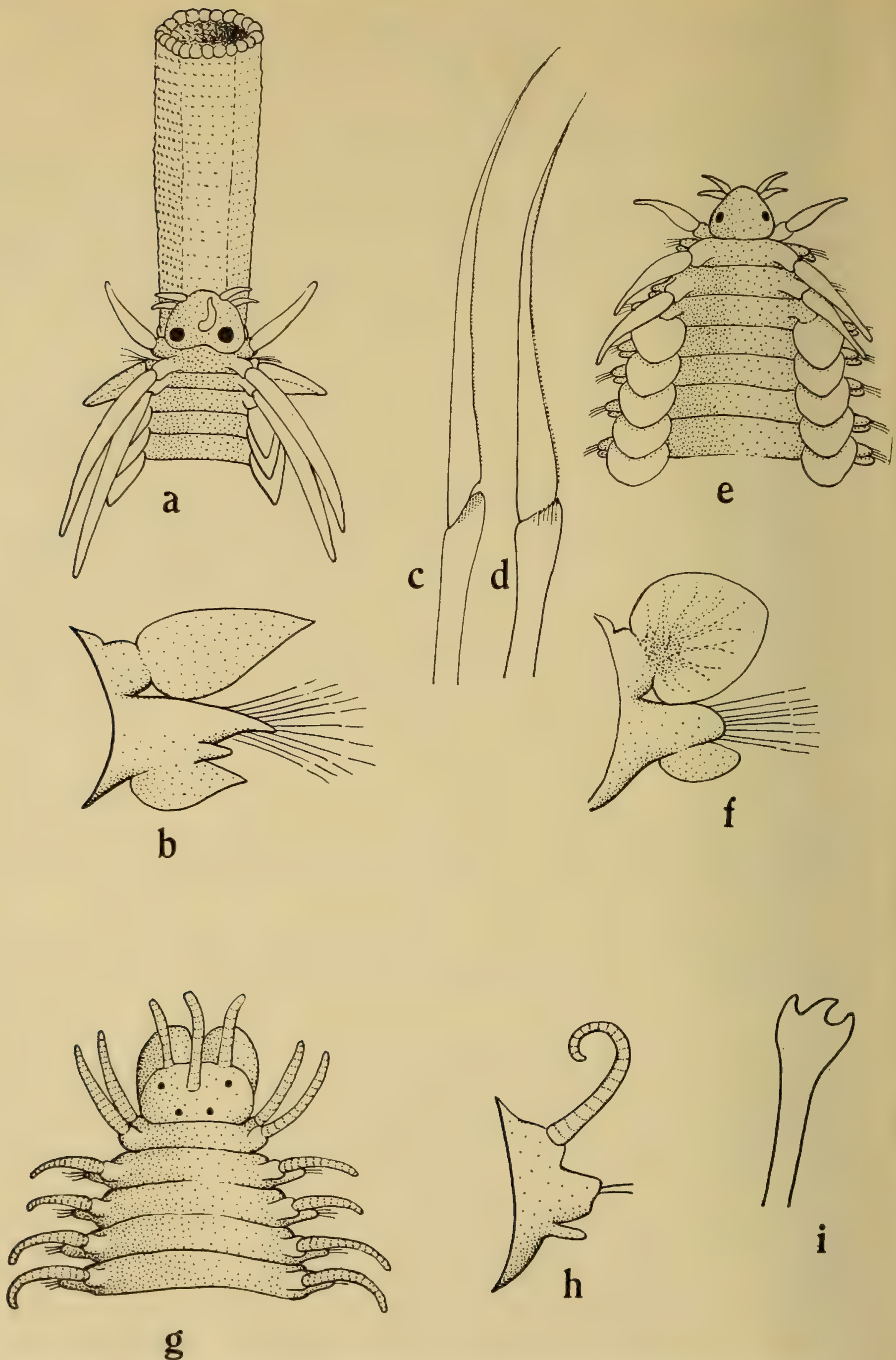

FIG. 6. *Eulalia falsa: a* head and proboscis; *b* anterior view of parapodium; *c* seta. *Protomystides capensis: d* seta; *e* anterior end; *f* anterior view of parapodium. *Syllis trifalcata: g* head; *h* parapodium; *i* seta.

Eulalia trilineata Saint Joseph 1888

Eulalia trilineata. Fauvel 1923, p. 162, fig. 57*m*.
Eulalia near albopicta Day 1951, p. 20.
Eulalia near trilineata Day 1953, p. 410.

Records: LAM.5(1), 10(1), 22(1), 35(1); FAL.22(2), 27(3), 81(1), 103(2), 113(7), 128(1), 131(1), 145(2), 152(1), 219(1), 245(1), 260(2), 262(2); LIZ.29(1).

Notes: The numerous specimens now available allow me to confirm the identity of this common South African species with Fauvel's brief description. Apart from the colour pattern the setae are quite characteristic. There are relatively few setae (10–15), the shaft-heads are markedly swollen and the blades are very short and strongly tapered. In 1951 I suggested that a specimen from Port St. Johns was close to *E. albo-picta* Marenzeller from Japan. Since then I have been able to consult Izuka (1912) who gives an excellent description of this species. It has tentacular cirrus V_2 flattened and there are setae on the second tentacular segment. In *E. trilineata* V_2 is almost cylindrical and there are no setae on the second tentacular segment.

Notophyllum splendens (Schmarda) 1861

Notophyllum splendens. Day 1953, p. 408, fig. 2 *h–k*.

Records: LAM.44(1); TB.302(1), 303(1), 309(1), 310(1); TRA.122(1), 143(1); FAL.27(1), 31(p), 56(1), 80(p), 149(1), 162(1).

Eteone foliosa Quatrefages 1865

Eteone foliosa. Fauvel 1923, p. 174, fig. 62 *g–k*. Day 1953, p. 411.

Records: SB.183(3), 189(1), 195(1); LB.323(1); TB.301(1); FB.302(1); FAL.110(1); FAL.113(3); FAL.228(1); ?FAL.375(2).

Eteone (*Mysta*) *syphodonta* (Delle Chiaje) 1822

Eteone (*Mysta*) *siphonodonta.* Fauvel 1923, p. 178, fig. 63 *e–h*.

Records: FAL.349(1); TRA.113(1); SCD.61(1).

Notes: The body is brown to mauve dorsally and pale ventrally. The prostomium is white, bluntly triangular and depressed with a pair of eyes which are visible through the skin. The two pairs of antennae are subequal and rather slender. The tentacular cirri are equal. The first normal segment lacks a dorsal cirrus but has a small ventral cirrus and a setigerous lobe with several setae. The dorsal cirri are 1·5–2 times as long as broad and borne on rather long broad cirrophores. The ventral cirri are bluntly pointed and a little longer than the blunt setigerous lobes. There are 15–20 setae with fairly long, evenly tapered blades and shaft-heads which are asymmetrical having one large tooth and 3–5 denticles. The proboscis when dissected proved to have two ventro-lateral

rows of large triangular papillae, a broad brownish dorsal band of minute flattened and denticulate papillae and a much narrower ventral band of slightly larger globular papillae.

This is the first record from South Africa but the above description agrees very well with that of Fauvel with the exception that the dorsal cirri are a little longer.

Eteone sp.

Records: TRA.108(1).

Notes: Specimen TRA.108.K is an unidentified species of *Eteone* new to South Africa. It is dirty white in alcohol and 15 mm. long. The prostomium is unusually long and slender and somewhat reminiscent of a *Glycerid.* It is tapered and over twice as long as the basal breadth with two pairs of stumpy antennae one behind the other and a pair of well-developed eyes posteriorly. Behind the eyes the head swells out to encompass the proboscis which had been lost. The two pairs of tentacular cirri are very small; the dorsal pair is no more than an elongate papilla and the ventral is only one-third the breadth of the tentacular segment. The next segment has only a ventral cirrus there being neither a dorsal cirrus nor setigerous lobe nor setae. All the parapodia are small. The dorsal cirrus is roughly semicircular and no broader than its cirrophore. The setigerous lobe is rather elongated with a blunt apex and the ventral cirrus is ovoid. There are about 10 setae per bundle each having an asymmetrical shaft-head with a large tooth on one side and a minute one borne on a projecting lobe on the other. The blade is broad basally but tapers rapidly to a slender tip.

This species is definitely new to South Africa and the slender prostomium and tiny tentacular cirri suggest that it may be a new species but until the nature of the proboscis is known it is not advisable to give it a specific name.

Protomystides capensis n. sp.

(Fig. 6 *d–f*)

Records: TRA.86(1); WCD.28(1).

Description: The holotype is a slender orange worm from TRA.86 richly speckled with red. It is 17 mm. long by 0·7 mm. wide with 110 segments, and is well tapered at each end.

The prostomium (fig. 6*e*) is small and cordate, a little longer than broad with two pairs of slender antennae and a pair of laterally placed eyes. Dissection showed that the proboscis had been lost. There are 3 pairs of small subulate tentacular cirri on three segments according to the formula $1 + S\frac{1}{N} + S\frac{1}{N}$. The first tentacular segment is fused to the prostomium and its cirrus is cylindrical and markedly tapered distally. The second segment is broad and

distinct, its dorsal cirrus is oval in section and about 1·5 times as long as the prostomium. The setigerous lobe is well developed and bears several setae. The ventral cirrus (V_2) is quite definitely similar to those of normal body segments. The third tentacular segment is also distinct but rather narrow and its cylindrical dorsal cirrus is markedly tapered and only two-thirds the length of that on the second segment. The setigerous lobe, setae and ventral cirrus are similar to those of the succeeding body segments.

Normal body segments are depressed and the dorsal cirri are well to the sides so that most of the back is uncovered. Each dorsal cirrus (fig. 6*f*) is symmetrically cordate and about as broad as long. The setigerous lobe is rather long and has a simple blunt apex, the presetal lobe not being notched as is the case in most Phyllodocids. The ventral cirrus is ovoid and possibly a little longer than the setigerous lobe. There are about 12–18 compound setae (fig. 6*d*) with swollen, symmetrical and almost truncate shaft-heads which bear a series of very fine subequal teeth distally. The blade is short and strongly tapered.

Protomystides is a rare genus and as far as I am aware no species has been described from the southern oceans, certainly none has been described from South Africa. Bergström (1914) describes *P. bidentata* from the North Atlantic and Mediterranean as having all the tentacular segments fully developed, and free from the prostomium.

Family *HESIONIDAE*

Syllidia armata Quatrefages 1865

Magalia perarmata Mar. et Bobr., Fauvel 1923, p. 246, fig. 92.

Records: SB.115(1), 183(3), 184(1), 207(1); TRA.86(1), 88(1); FAL.31(1), 43(2), 136(6), 145(1), 164(2), 174(1), 266(1), 275(1), 283(1); MB.88(1); LIZ.9(2).

Kefersteinia cirrata (Keferstein) 1863

Kefersteinia cirrata. Fauvel 1923, p. 238, fig. 89 *a–e*.

Records: FAL.283(4).

Notes: This is a new record for South Africa, but the characters agree very well with Fauvel's description.

Family *SYLLIDAE*

Syllis (*Haplosyllis*) *spongicola* Grube 1855

Syllis (*Haplosyllis*) *spongicola*. Fauvel 1923, p. 257, fig. 95 *a–d*.

Records: AFR.707(1), 842(1); TRA.151(1); MB.16(2); SCD.54(1).

Syllis (*Haplosyllis*) *trifalcata* n. sp.
(Fig. 6 *g–i*)

Records: FAL.216(1).

Diagnosis: The dorsal cirri have 8–12 joints, and the setae have 3 falcate teeth.

Description: The holotype is 9 mm. by 0·4 mm. with 88 segments. There are no colour markings. The head (fig. 6*g*) is broader than long with rather flattened palps bent ventrally but not united at the base. The antennae are subequal and rather short. There are 4 eyes. The pharynx has an anterior dorsal tooth and extends back to setiger 9 and the cylindrical proventriculus with 40 rows of points then extends on to setiger 16.

The tentacular cirri and dorsal cirri are short, tapered and twist like pigs' tails; they have 9–12 well-marked joints. The setigerous lobes (fig. 6*h*) are obliquely truncate cones and the ventral cirri are small. There are 2 acicula with blunt tips. Each parapodium contains 3–6 simple setae (fig. 6*i*) which are all similar, each having an expanded end (corresponding to the shaft-head) bearing 3 claw-like teeth of about the same size.

The common *S.* (*H.*) *spongicola* Grube has dorsal cirri with more joints and the setae are roughly like boat-hooks with 2 small teeth above a large triangular rostrum. *S.* (*H.*) *depressa* Augener 1913 from Australia has setae with only 2 teeth rather like the open beak of a bird. *S.* (*H.*) *abberans* Fauvel 1919 from Indochina is fairly close but the dorsal cirri are long and apparently not jointed; moreover the setae are narrowed before the apex which has teeth approaching those of *S.* (*H.*) *spongicola.*

Syllis vittata Grube 1840

Syllis vittata. Fauvel 1923, p. 263, fig. 98 *i–l.* Day 1953, p. 412.

Records: LAM.22(1); FAL.82(1), 134(1), 171(2); MB.66(1).

Notes: Specimens LAM.22.W and FAL.171.Z are doubtfully referred to *S. vittata.* The body is creamy white without markings and rather stout. The pharynx is short. Dorsal cirri have about 20 joints. The setae always have a very small secondary tooth and in the middle of the body they tend to be short and hooked.

Syllis variegata Grube 1860

Syllis variegata. Fauvel 1923, p. 262, fig. 97 *h–n.* Day 1953, p. 412.

Records: LAM.22(1); SB.189(1), 197(2); WCD.8(2), 19(4); FB.307(4); FAL.8(p), 113(2), 128(1), 131(1), 134(1), 145(2), 156(5), 162(12), 174(2), 178(2), 302(1), 303(1); MB.86(1); LIZ.2(1), 9(1), 29(1).

Syllis prolifera var. zonata (Haswell) 1886

Syllis zonata Augener 1918, p. 236, pl. 4, fig. 86; pl. 5, fig. 107, text-fig. 19.

Records: LAM.25(1), 31(1), 44(1), 47(1), 57(1), 59(1); SB.197(1); TB.332(1); FAL.31(8), 81(p), 103(1), 110(p), 128(1), 134(1), 145(2), 149(3), 156(3), 162(20), 166(2), 171(19), 219(1), 275(2), 280(1); LIZ.18(1).

Notes: Like *S. variegata* this species has dorsal cirri with 25–35 joints and strongly bidentate setae; it differs in having a short pharynx and in having two narrow black lines across the anterior segments where *S. variegata* has a pattern of broken brown bars.

Syllis armillaris Müller 1776

Syllis armillaris. Fauvel 1923, p. 264, fig. 99 *a–f*. Day 1953, p. 412.

Records: Lamberts Bay 13 records from 17–23 metres on rock. Common. SB.207(1); TB.305(6), 306(1), 308(2), 309(1), 331(4); SH.168(2), 204(1), 366(1), 415(2); WCD.8(2); False Bay—27 records from 0–33 metres on rock (common). AFR.835(1), 967(1); MB.13(1); LIZ.18(1), 36(2), 37(2); SCD. 9(2), 22(1), 106(1).

Syllis gracilis Grube 1840

Syllis gracilis. Fauvel 1923, p. 259, fig. 96 *f–i*. Day 1953, p. 412.

Records: FAL.17(2), 50(1), 166(2), 275(2), 280(1); MB.86(1); LIZ.2(1).

Syllis hyalina Grube 1863

Syllis capensis McIntosh 1885, p. 193, pl. 33, figs. 8–9; pl. 15A, fig. 21.
Syllis hyalina. Fauvel 1923, p. 262, fig. 98 *a–b*.

Records: MB.57(1), 86(1).

Notes: The type of *Syllis capensis* from the Cape is now in the British Museum. It is a small worm and probably immature. The dorsal cirri are cylindrical not fusiform and have 13 joints anteriorly, 11 in the middle of the body and 10 posteriorly. There are 6–10 strongly bidentate setae per foot.

The specimens from Mossel Bay (MB.57 and 86) are referred to *S. hyalina* with some hesitation for the dorsal cirri have 15–20 joints. The setae are strongly bidentate but in superior setae the two teeth are very close together and project at right angles to the blade somewhat in the fashion shown by Gravier for *S. bouvieri*.

Syllis cf. trapobanensis Willey 1905
(Fig. 7*a*)

Typosillis taprobanensis Willey 1905, p. 268, pl. 3, figs. 77, 78.

Records: TRA.55(4); SCD.54(1).

Notes: There are faint transverse bars across the anterior segments when fresh but these soon fade in alcohol leaving the body white. The body is of the usual size (16 mm.) and shape. The palps are rather flattened and short but separate at the base. The pharynx is strongly chitinised and the dorsal tooth is rather small. There is no sign of an occipital flap. The dorsal cirri are rather long and markedly tapered with 20–30 joints. The setigerous lobes are stout and the ventral cirri slender. The setae (fig. 7*a*) are characteristic and all similar. There are 10–12 per bundle and each has a swollen shaft-head with a short almost triangular blade with two large blunt teeth.

Syllis (*Langerhansia*) *anops* Ehlers 1897

Syllis (*Ehlersia*) *anops* Ehlers 1897, p. 40, pl. 2, figs. 40–45.

Records: FAL.248(1).

Notes: A single incomplete specimen was obtained measuring 16 mm. for 45 segments. It is a threadlike worm with slender dorsal cirri. The prostomium lacks eyes, has large palps fused at the base and short antennae. The tentacular cirri are a little longer but still shorter than the anterior dorsal cirri. The pharynx has the dorsal tooth at its anterior margin and stretches back to setiger 9. The proventriculus is also long and extends back from setiger 9 to setiger 18. The uniformly slender dorsal cirri are about as long as the body is broad and have 20–25 joints. The setigerous lobe is in the form of an obliquely truncate cone and the ventral cirrus is slender and a little longer than the foot. The setae are similar throughout. In each foot there are 2–3 superior setae with very long tapering swordlike blades which give the impression of having minutely knobbed tips. Below these there are about 12 setae with unidentate blades of normal length.

The South African specimen agrees with Ehlers' species from the Magellan area in all respects save one. Ehlers states that the anterior setae are bidentate and his figure (pl. 2, fig. 44) shows both the *Ehlersia* type and the normal setae each with a small secondary tooth. In my specimen all setae agree with his pl. 2, fig. 45, which shows the blades of both types of setae with unidentate tips.

This is a new record for South Africa.

Syllis (*Langerhansia*) *ferrugina* Langerhans 1881

Syllis (*Ehlersia*) *ferrugina*. Fauvel 1923, p. 269, fig. 100 *k–u*.

Records: SB.183(3), 189(1); FAL.149(1).

Notes: This is the first record from South Africa but Augener (1918) recorded it from Angola.

Syllides longocirrata Oersted 1845

Syllides longocirrata. Fauvel 1923, p. 284, fig. 108 *a–g*.

Records: FAL.65(1), 82(1).

Notes: The body is small and the pharynx lacks teeth. The antennae, tentacular cirri and the first two pairs of dorsal cirri are unjointed but the

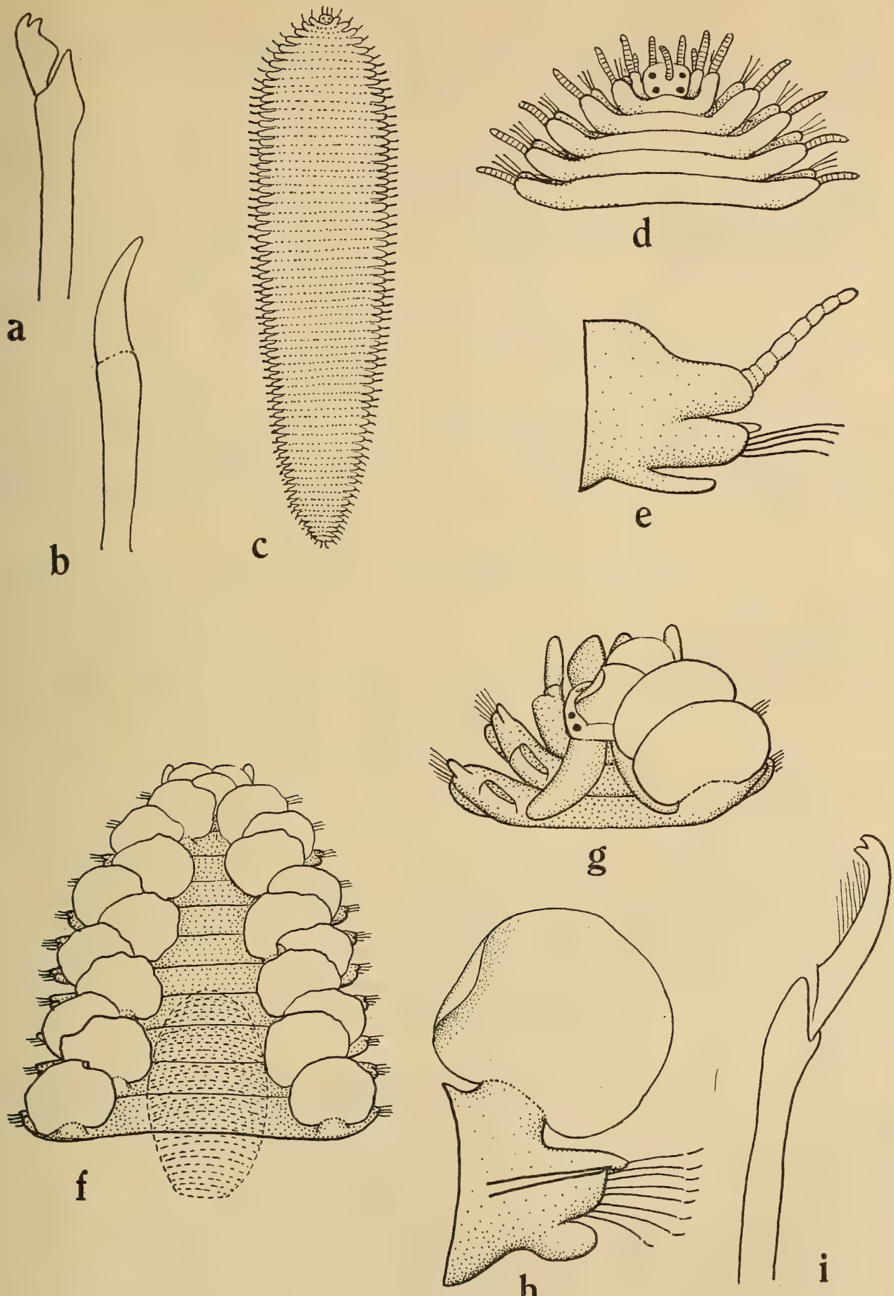

Fig. 7. *Syllis cf. taprobanensis: a* seta.
Trypanosyllis ankyloseta: b seta; *c* entire animal; *d* anterior end; *e* middle parapodium.
Lamellisyllis comans: f anterior end; *g* head with left antenna and dorsal cirri removed; *h* parapodium; *i* seta.

remaining dorsal cirri are very long and deeply annulated with 12–15 joints. The setae have long tapered blades with indistinct tips which are possibly unidentate. This is a new record for South Africa.

Trypanosyllis zebra Grube 1860

Trypanosyllis zebra. Fauvel 1923, p. 269, fig. 101 *a–e*. Day 1953, p. 413.

Records: FB.322(1); LIZ.9(1).

Trypanosyllis gemmulifera Augener 1918

Trypanosyllis gemmulifera Augener 1918, p. 278, pl. 5, figs. 99–101, text-fig. 27. Day 1953, p. 413.

Records: LAM.4(*c*), 10(1), 15(2), 18(3), 22(3), 33(1), 35(3), 43(1); SB.132(2); LB.161(1); TB.306(2); SH.324(1); AFR.842(1); TRA.102(3), 110(1); WCD.8(3); FAL.57(p), 103(p), 106(p), 145(1), 149(5), 171(1), 184(1), 216(2); MB.9(1), 13(1), 16(1), 53(2), 67(3), 77(1), 86(1); LIZ.29(3).

Trypanosyllis prampramensis Augener 1918

Trypanosyllis prampramensis Augener 1918, p. 276, pl. 4, figs. 91, 92, text-fig. 26. Day 1953, p. 414.

Records: FAL.156(1).

Trapanosyllis ankyloseta n. sp.

(Fig. 7 *b–e*)

Records: FAL.216(1).

Diagnosis: A short broad body, dorsal cirri with 6–8 joints, simple setae with the blade fused to the shaft-head.

Description: The holotype is the single specimen dredged in False Bay at 32°12·4′S/18°43·5′E at a depth of 42 metres on a sand and rock bottom. The specimen (fig. 7*c*) is very broad and short and markedly flattened. It measures 8 mm. by 1·8 mm. and is roughly oval with about 120 segments. The colour is yellowish white in alcohol.

The prostomium (fig. 7*d*) which is sunk in between the anterior segments, is rectangular with 4 large eyes, a pair of ovoid palps directed ventrally and 3 short antennae. The lateral pair are anterior in origin and have 6 joints while the median arises from the centre of the prostomium and has 8 joints. The tentacular cirri are borne on anteriorly directed projections arising between the prostomium and the first pair of parapodia and the tentacular segment is not visible dorsally. The dorsal pair of tentacular cirri are longer than the ventral pair and are about equal to the dorsal cirri of setiger 1. The mouth is ventral and the long pharynx is folded on itself in the dorso-ventral plane. The trepan has about 10 teeth. The proventriculus which has about 40–50 rows of points extends from setiger 16–26.

Anterior segments increase in width until an average segment in the middle of the body is about 20 times as broad as long. Posterior ones decrease again as the body tapers to an oval anterior end. The parapodia (fig. 7*e*) are similar throughout. Each has a short dorsal cirrus of 6 to 8 joints borne on a broad projecting cirrophore. Below this is the setigerous lobe with a terminal papilla and below this again is the somewhat shorter ventral cirrus. The 4–5 setae (fig. 7*b*) are not compound but simple since the falcate unidentate blade has become fused to the shaft-head. The posterior end tapers to a bilobed pygidium bearing a pair of ovoid anal cirri with 3–4 joints.

Odontosyllis polycera (Schmarda) 1861

Odontosyllis polycera. Augener 1918, p. 283, pl. 5, fig. 97. Day 1953, p. 415.

Records: LAM.31(2); FAL.23(p), 31(1), 50(3), 82(2), 104(p), 113(2), 164(1), 365(1); MB.57(2), 87(4).

Odontosyllis ctenostoma Claparede 1863

Odontosyllis ctenostoma. Fauvel 1923, p. 277, fig. 104 *f–l.*

Records: TRA.121(1).

Notes: This species has been recorded from Angola by Augener (1918) but this is the first record for South Africa.

Pharnygeovalvata natalensis Day 1951

Pharyngeovalvata natalensis Day 1951, p. 26, fig. 4 *e–j.*

Records: FAL.171(1).

Notes: The single specimen is incomplete but measured 9 mm. for 48 segments and is thus larger than the type. It has a general resemblance to *Odontosyllis ctenostoma* but the structure of the pharynx is characteristic.

Amblyosyllis lineolata (Costa) 1864

Pterosyllis formosa Clap. Fauvel 1923, p. 280, fig. 105 *h–n.*
Amblyosyllis lineolata Day 1953, p. 415.

Records: FAL.136(2), 159(1), 162(1), 171(1).

Pionosyllis ehlersiaeformis Augener 1913

Pionosyllis ehlersiaeformis Augener 1913, p. 225, pl. 3, fig. 32; text-fig. 31 *a–e.*
non *Pionosyllis ehlersiaeformis* Day 1953, p. 415, fig. 3*d.*

Records: WCD.13(8); FAL.269(4).

Notes: The material consists of four ovigerous females 4–8 mm. long living in mucus tubes attached to hydroids. Two of them had developing embryos on their backs.

The prostomium bears 3 antennae on its anterior margin and the median, which is the longest, is twice the length of the prostomium. There are 4 large eyes and broad palps which are united basally and bent ventrally. The tentacular segment is short and distinct from the prostomium. It bears two pairs of tentacular cirri, the longer dorsal pair being equal to the median antennae.

The dorsal cirri are smooth and tapered. The pair on the first setiger are about 1·5 times the breadth of the body but succeeding ones are shorter and over most of the body the dorsal cirri are only two-thirds the breadth of the body. Some of the cirri are wrinkled but none are annulated.

There are 10–12 setae per foot. Those of the first foot are stouter than the rest and at certain angles the blade almost appears fused to the shaft but in the following feet the majority of the setae are clearly compound with bidentate blades. A single slightly curved, simple needle-like seta appears on the 10th foot and a little later two *Ehlersia-type* compound setae with very long slender blades. Beneath these are several compound setae with shorter blades with two large terminal teeth. An inferior simple seta was not seen but in two specimens natatory setae with immensely long blades were found in posterior feet.

Augener's descriptions of the dorsal cirri are not quite consistent for in the first account (Augener 1913) he states that the dorsal cirri are not ringed and in the second (Augener 1918) he says that they are.

The tendency for transverse wrinkling or indistinct ringing is common in the genus and it is possible that the different descriptions are due to variations in methods of preservation.

Augener (1918) suggested that *P. malmgreni* described by McIntosh (1904) from False Bay as having 20–30 annulations to the dorsal cirri was synonymous with his *P. ehlersiaeformis*. In Day (1953) I followed Augener but noted that my specimen did not have true *Ehlersia*-type setae. I now feel that they should be kept separate for the Cape form of *P. malmgreni* lacks the *Ehlersia*-type superior setae, has 20–30 indistinct joints to the dorsal cirri and grows to a much larger size (40 mm. as against 8 mm.).

Pionosyllis cf. longocirrata St. Joseph 1887

Pionosyllis cf. longocirrata. Fauvel 1923, p. 288, fig. 110 *h–l*.
Pionosyllis sp. Day 1953, p. 418, figs. 3 *e–f*.

Records: SH.204(2), 415(1).

Notes: These specimens show many similarities to Fauvel's description but the identification remains uncertain. All three individuals are soft and fragile and have broken in several places but might measure 15 mm. if complete. The prostomium has 2 pairs of eyes and the anterior pair are larger and further apart. The palps are fused at their bases and bent ventrally. The pharynx is short with a smooth rim and a fairly large anterior tooth. The proventriculus

has about 30 rows of points. The dorsal cirri are very long, smooth, tapered and over twice the breadth of the stout body. The anterior ventral cirri are large and triangular but not lamellar and further back they become more digitiform. The setae are very long and fine. The blades themselves are slender, and not obviously tapered. The tips are bidentate and as shown in Day (1953) figs. 3 *e–f*, there is a strong hooked terminal tooth with a slender tooth directed obliquely towards it. There are also faint indications of a hood over the terminal tooth. No simple setae were seen.

The European *P. longocirrata* has even longer dorsal cirri, up to 4 times the body breadth but Fauvel's figure 110*h* does not suggest that they are tapered and his figure of the seta (110*l*) does not suggest a hooked terminal tooth.

Pionosyllis magnidens Day 1953

Pionosyllis magnidens Day 1953, p. 416, fig. 3 *a–c*.

Records: FAL.132(2), 174(3), 178(1).

Grubea furcelligera Augener 1913

Grubea furcelligera Augener 1913, p. 256, pl. 3, figs. 20, 21; text-figs. 39.

Records: FAL.275(2).

Notes: The material consists of two females with natatory setae carrying developing embryos on their backs. They are colourless in alcohol. The best preserved measures 5 mm. in length and has 40 segments. The prostomium is rounded with a pair of palps which are square in front, fused for most of their length but with the distal ends free. There are 3 antennae all arising from the anterior margin of the prostomium. All are bottle-shaped with tapered ends and the median is twice the length of the laterals which are equal to the width of the body (not including the parapodia) at the level of setiger 1. There are 4 eyes. The pharynx extends back to setiger 4 with the dorsal tooth near the anterior end. The barrel-shaped proventriculus extends over a further 2 segments.

The tentacular segment is clearly marked off from the prostomium but is very narrow and not very distinct from setiger 1. It bears the usual 2 pairs of tentacular cirri, of the same elongate subulate shape as the antennae. The dorsal pair which is twice as long as the ventral pair is equal to the median antenna. The dorsal cirri are similar to the antennae and the tentacular cirri but vary in length; the dorsal cirri of setiger 1 are $\frac{3}{4}$ the length of the antennae, those of setiger 2 are very short and hardly exceed the length of the setigerous lobe, those of setigers 3 and 4 increase again and the dorsal cirri of setigers 5 and subsequent segments are about half as long as the tentacular cirri or a little over half the width of the segment that bears them. The setigerous lobes are short truncate cones and the ventral cirri are rather stout and ovoid.

The normal compound setae have swollen shaft-heads and very small, unidentate dagger-like blades. There is also a single pointed simple seta in the

superior part of each bundle. The natatory setae appear in setiger 9. Each has a long slender shaft from which arises a very fine hair-like tapered blade.

This South African material lacks the small anterior third pair of eyes described by Augener and the antennae, tentacular cirri and dorsal cirri of setiger 1 are considerably longer than Augener describes, possibly due to differences in preservation. This is a new record for South Africa.

Grubea rhopalophora Ehlers 1897

Grubea rhopalophora Ehlers 1897, p. 53, pl. 3, figs. 66–70. Augener 1918, p. 295, pl. 4, fig. 94.

Records: FAL.17(1), 246(2); MB.85(1).

Notes: The Cape material agrees perfectly with Ehler's description and I can confirm that the compound setae are unidentate. This species has previously been recorded by Augener (1918) from the shore at Swakopmund and shallow dredgings at Lüderitzbucht in South West Africa. In his notes on individuals from Lüderitzbucht Augener describes two with minute and truncate dorsal cirri containing fibrillar structures. These agree very closely with the description of Fauvel (1923) of *Grubea pusilla* (Dujardin).

Grubea rhopalophora is generally similar to *G. limbata* Claparède but differs in the fact that the antennae, and dorsal cirri are shorter with more swollen bases, the tentacular segment is more completely fused with the prostomium and the palps separate towards their extremities.

Sphaerosyllis sublaevis Ehlers 1913

Sphaerosyllis sublaevis Ehlers 1913, p. 482, pl. 32, figs. 10–15.

Records: SB.167(1); FAL.82(1); TRA.113(1).

Notes: These specimens agree very well with Ehlers' description. The body surface is smooth and there is no dorsal cirrus on setiger 2. The antennae, tentacular cirri and anterior dorsal cirri are all small and flask-shaped with swollen bases and tapered ends but further back the dorsal cirri become longer and more bottle-shaped. The setae have unidentate blades. Ehlers states that there is a third minute pair of eyes on the anterior margin of the prostomium. Their absence in the present specimens is not regarded as important as it has been noted that such eye-specks are often invisible in individual specimens of Syllids.

S. sublaevis is close to *S. claparedii* Ehlers (1864) but the latter is reported to have a dorsal cirrus on setiger 2.

Sphaerosyllis hystrix Clap. var. *capensis* Day 1953

Sphaerosyllis hystrix Day 1953, p. 420, fig. 4 *g–l*.

Records: SB.183(2).

Exogone clavator Ehlers 1913

Exogone clavator Ehlers 1913, p. 485, pl. 33, figs. 1–6. Day 1953, p. 418.

Records: WCD.5(1); SB.183(4); FAL.17(7), 110(1), 131(6), 152(1), 159(2), 266(1); MB.57(1); LIZ.29(1).

Exogone gemmifera (Pagenstecher) 1862

Exogone gemmifera. Fauvel 1923, p. 305, fig. 117 *a–d.*
Exogone verugera (non Claparède) Day 1953, p. 418.

Records: SB.167(2); FAL.22(7), 82(2), 103(3), 128(1), 178(10), 280(1).

Notes: In 1953 I referred several specimens to *E. verugera* though it was noted that they lacked a dorsal cirrus on setiger 2. Examination of a great deal more material from both South Africa and Europe and the discovery of the typical *E. verugera* in South Africa has shown that the presence or absence of a dorsal cirrus on setiger 2 is a constant and important character. It is now possible to summarize the main differences between the three closely related species *E. verugera*, *E. gemmifera* and *E. heterosetosa*, all of which occur in the Southern hemisphere.

In *E. gemmifera* the palps are short and broad, the three antennae are of equal size and about the same length as, or a little longer than, the prostomium. The proventriculus is short, extending over 1–2 segments, and has 10–12 rows of points. The superior compound seta has a long dagger-like blade. There is no dorsal cirrus on setiger 2. In *E. heterosetosa* the palps are short and the three antennae are about the same length as the prostomium. The proventriculus is rather long, extending over 3 segments and has 15 or more rows of points. The superior compound seta has a characteristically swollen shafthead and a short broad blade. There is no dorsal cirrus on setiger 2. In *E. verugera* the palps are rather long and tapered and the three antennae are equally minute and much shorter than the prostomium. The proventriculus is fairly long, extending over 2–3 segments and has 25–30 rows of points. The superior seta has a dagger-like blade. There is a dorsal cirrus on setiger 2.

Exogone verugera Claparède 1868

Exogone verugera. Fauvel 1923, p. 307, fig. 117, figs. *m–r.*

Records: SH.400(1); FAL.162(13); SCE.54(1).

Notes: The diagnostic characters of this species are given above.

Autolytus charcoti Gravier 1906

Autolytus charcoti Gravier 1906, p. 7, pl. 1, figs. 1, 2.
?*Autolytus afer* Ehlers, 1908b, p. 46.

Records: TB.312(1); FAL.247(1); LIZ.29(1).

Notes: Specimen TB.312 measures 15 mm. for 75 segments. The body has conspicuous black bands at the intersegmental junctions starting at setiger 1/2 then every junction to setiger 6/7, then misses 7/8 and 14/15 and thereafter is present on every fourth junction to the end of the body. On specimen LIZ.29 every intersegmental junction from 2/3 onwards is banded.

Diverging nuchal epaulettes extend from the back of the prostomium to setiger 2. The trepan has 10 equal teeth. The antennae, tentacular cirri and the dorsal cirri of setiger 1 are stout and just longer than the width of the body, but thereafter the dorsal cirri decrease and in the middle of the body they are rather less than one-third the body width.

The specimen described by Ehlers (1908) from Lüderitzbucht as *A. afer* agrees in general characters, but as it was preserved in osmic acid no details of colour pattern are available.

Autolytus tuberculatus (Schmarda) 1861

Autolytus tuberculatus. Augener 1918, p. 307. Day 1953, p. 421.

Records: FAL.22(1), 82(7), 103(3), 113(1), 122(1), 145(1), 159(1), 162(1), 171(2), 247(1), 280(5); ?LIZ.58(1).

Notes: Further material has shown that the length of the nuchal epaulettes is variable. They may reach setiger 6 or hardly reach setiger 4. Anterior dorsal cirri are unequal; those of setigers 1, 2, 4 and 6 are much longer than those of setigers 3, 5 and 7 or subsequent segments. In the middle of the body they are only one-third to one-half of the width of the body.

Autolytus prolifer (Müller) 1788

Autolytus prolifer. Fauvel 1923, p. 311, fig. 119.

Records: FAL.334(1); MB.58(1), 69(1); SCD.40(1).

Notes: The pharynx is S-shaped and crowned with 10 large triangular teeth. Indistinct nuchal epaulettes are present on setiger 1 but do not extend on to setiger 2. The antennae, tentacular cirri and dorsal cirri of the first setigers are long but the remaining ones are only one-third to one-quarter the width of the body.

Autolytus maclearanus McIntosh 1885

Autolytus maclearanus. Ehlers 1913, p. 488, pl. 33, figs. 9–11.
Autolytus inermis (non St. Joseph) Ehlers 1913, p. 488.

Records: SH.430(20); FAL.43(1); SCD.61(3).

Notes: This South African material agrees very well with the species described by Ehlers from Kerguelen under the name of *A. maclearanus.* McIntosh's original description is so vague that it might refer to any species of *Autolytus*, but Ehlers's description and figures are clear.

The diagnostic features are the long antennae, dorsal tentacular cirri and dorsal cirri of setiger 1. All of these greatly exceed the width of the body and are often so wrinkled as to give the impression of being annulated which they are not. The dorsal cirri of normal body segments are about one-third of the body width. The tentacular segment is much shorter than setiger 1 and on some specimens it has vague indications of small nuchal epaulettes as stated by Ehlers. The pharynx has 6 rounded lappets instead of sharp chitinous teeth at its entrance. These were only seen when the pharyngeal sheath was dissected away and the pharynx was first thought to be unarmed as in *A. inermis*. The latter species, however, has a doubly convoluted pharynx while the present species has a single large loop.

Ehlers stated that the proventriculus of his Kerguelen specimen lay in the 7th segment. Here it is in the 4th and has 30 rows of points. In fresh material it is faintly greenish.

Myrianida phyllocera Augener 1918

Myrianida phyllocera Augener 1918, p. 301, pl. 4 figs. 87–89, text-fig. 30. Day 1953, p. 421.

Records: FAL.178(1); LIZ.2(1).

Lamellisyllis gen. nov.

Prostomium with 3 lamellar antennae. Palps united at their bases. Pharynx straight with an anterior dorsal tooth. Prominent nuchal epaulettes. A single pair of cylindrical tentacular cirri. Dorsal cirri lamellar, setae compound, ventral cirri on all segments. Type species *L. comans*.

Lamellisyllis comans n. sp.

(Fig. 7 *f–i*)

Records: FAL.110(1).

Description: The holotype is a pale, flattened worm, roughly *Harmothoid* in outline and measures 8 mm. for 50 segments. The prostomium is sunk back between the anterior segments which project forwards and outwards so that the front end of the body (fig. 7*f*) appears rounded. The palps are normal and united only at their bases. The small rounded prostomium (fig. 7*g*) has 4 eyes set in a rectangle and 3 subequal foliaceous antennae. The lateral pair arise from the anterior margin while the median arises from the centre of the prostomium. The mouth is ventral and the straight, weakly chitinized pharynx bears a single dorsal tooth near its anterior margin. It extends back to setiger 7 and the barrel-shaped proventriculus with 20 rows of points extends on to setiger 12.

Two grooved, finger-like nuchal organs diverge from the posterior margin of the prostomium towards the sides of setiger 3. They were first thought to lie freely on the dorsum but attempts to move them showed that they are

attached throughout their length. A single pair of tapered and cylindrical tentacular cirri project forwards on either side of the prostomium. This pair corresponds to the ventral cirri of a normal segment for each arises from a lobe of the tentacular segment which is wedged between the prostomium and the first setiger and above it there is a lump which seems to correspond to a dorsal cirrophore.

The normal body segments (fig. 7*h*) are all similar. Each is about 20 times as broad as long and has a dorsal cirrus, a setigerous lobe and a ventral cirrus on its lateral margin. The dorsal cirrus is borne on a stumpy cirrophore placed well above the setigerous lobe and the cirrus itself is flattened, oval to circular in outline, and is attached to the cirrophore by its edge. Alternate dorsal cirri are more medial and more lateral in origin. The setigerous lobe is an obliquely truncate cone with a minute papilla at its apex. There is a pointed aciculum and about 20 compound setae (fig. 7*i*) whose blades are strongly bidentate and 'hairy'. The ventral cirrus is conical and slightly shorter than the setigerous lobe. The posterior end of the worm is markedly tapered and the pygidial segment bears a pair of foliaceous anal cirri.

The possession of foliaceous appendages is unusual in the family Syllidae. The genus *Myrianida* has flattened head appendages and dorsal cirri but the completely fused palps, the sinuous pharynx crowned with a trepan of teeth, the minutely-bladed compound setae and lack of ventral cirri immediately place it in the sub-family *Autolytinae*. *Phyllosyllis* Ehlers (1897) from South Georgia obviously belongs to the *Autolytinae* as well although it has setae on the tentacular segment. Knox (1957) has recently described *Clavisyllis* from New Zealand with inflated, ovoid dorsal cirri, normal ventral cirri, large nuchal epaulettes, palps united only at their bases and a straight pharynx with an anterior tooth. In these characters it is very similar to the present *Lamellisyllis*, but it differs in having cylindrical antennae, a nuchal cirrus between the nuchal epaulettes and two pairs of tentacular cirri. Possibly *Clavisyllis* should be included in the sub-family *Eusyllinae*. *Lamellisyllis* with its single pair of tentacular cirri shows resemblances to *Sphaerosyllis*, *Exogone* and *Spermosyllis* all of which belong to the sub-family *Exogoninae*. But all the members of the latter sub-family, have palps which are fused throughout their length so it might be better to place *Lamellisyllis* in a sub-family of its own.

The characters of *Clavisyllis* and *Lamellisyllis* show that the family *Syllidae* is closer to the family *Phyllodocidae* than had previously been realized.

Procerastea perrieri Gravier 1900

Procerastea perrieri. Fauvel 1923, p. 327, fig. 126 *a–c*.

Records: SH.430(4); SB.167(LC).

Notes: This is a new record for South Africa but the specimens agree perfectly with Fauvel's description. This species seems to feed on hydroids growing just below low-tide mark.

Family *NEREIDAE*

Laeonereis ankyloseta Day 1957

Laeonereis ankyloseta Day 1957, p. 83, fig. 5 *a–j*.

Records: FB.302(3), 307(6); FAL.8(1), 43(1), 50(1), 80(p), 110(2), 126(1), 171(1), 225(4), 249(1), 275(1), 304(1), 345(1); MB.13(1), 16(1), 40(1), 56(heteronereid), 62(1 juvenile), 86(1), 87(1), 88(3); LIZ.1(1), 9(1); SCD. 32(3), 54(2).

Notes: MB.62 is a juvenile which lacks the characteristic ankylosed setae but the other characters are typical. MB.56 is a heteronereid.

Nereis (*Neanthes*) *operta* Stimpson 1855

Nereis (*Neanthes*) *operta*. Day 1934, p. 38, fig. 5. Day 1951, p. 28. Day 1953, p. 424.

Records: LAM.4(1), 8(1), 16(1), 22(2), 25(1), 44(1), 51(1), 59(1), 61(1), 63(1); SB.118(1), 175(2), 179(1), 181(1), 189(15); SH.366(1), 428(1), TB. 302(1), 325(1), WCD.23(1); TRA.69(2 planktonic heteronereids), False Bay: 24 records from 2–38 metres on sand and rock. MB.49(1), 62(1), 87(6), 88(1); LIZ.6(6).

Nereis (*Neanthes*) *willeyi* Day 1934

Nereis (*Neanthes*) *willeyi* Day 1934, p. 38, fig. 6 *a–c*. Day 1951, p. 28. Day 1953, p. 424.

Records: False Bay: 22 records from 0–22 metres on sandy rocks. MB.40(4), 49(1), 59(1), ?71(1).

Nereis (*Neanthes*) cf. *kerguelensis* McIntosh 1885

Nereis kerguelensis. Ehlers 1897, p. 65, pl. 4, figs. 81–93.

Records: AFR.950(1); 994(1); TRA.143(1).

Notes: The largest of the three specimens measures 22 mm. It is pale brown in alcohol with a more intense bar across setiger 2. The proboscis has group I = 0; II = a wedge of 8–9 points; III = 5–6; IV = a wedge of 10 points; V = 0; VI = 2–5 in a close set group; VII and VIII = a single row of 3–5. Anterior feet have three notopodial lobes and a rather longer dorsal cirrus. In posterior feet there are only two notopodial lobes. There are no notopodial falcigers. The neuropodial falcigers have straight blades with a tendon towards the tip. This South African material differs from published descriptions of *N. keurguelensis* in having more denticles on group VI. In this and in the brown bar on setiger 2 it resembles *N. unifasciata* Willey but the latter only has two notopodial lobes on anterior feet.

Nereis (*Neanthes*) *succinea* Frey & Lueckart 1847

Nereis glandulosa Ehlers 1908a, p. 74, pl. 8, figs. 1–6.

Records: TRA.91(3); LIZ.1(7), 3(10), 38(1).

Nereis (*Nereis*) *lamellosa* Ehlers 1868

Nereis lamellosa Ehlers 1868, p. 564, pl. 22, figs. 10–17. Fauvel 1936, p. 36.

Records: TRA.33(3), 91(1); FB.306(6); FAL.184(1), 187(1), 206(1), 209(1), 223(4), 240(2); MB.4(3), 34(2), 75(2); SCD.20(1), 61(1), 94(3), 105(1).

Notes: As shown by Fauvel (1936) this species is very close to *N. succinea* but has dorsal homogomph falcigers in posterior feet. All neuropodial falcigers have feathered blades with a tendon from the apical tooth.

Nereis (*Nereis*) *zonata var. persica* Fauvel 1911

Neireis zonata var. *persica* Fauvel 1911, p. 385, pl. 19, figs. 10–16, 18–23; pl. 20, figs. 24–25.

Records: SH.71(1); SCD.50(1), 63(1).

Notes: This species which is well known from the tropical Indian Ocean has been found as far south as Moçambique (Day 1957). The present records show that it extends even further south in dredgings off the eastern Cape Province. It has also been found on the hull of a ship visiting Table Bay from the Indian Ocean.

Nereis (*Nereis*) *jacksoni* Kinberg 1866

Nereis (*Nereis*) *jacksoni*. Fauvel 1932, p. 97.

Records: LIZ.27(2); SCD.100(1).

Nereis (*Nereis*) *falsa* Quatrefages 1865

Nereis falsa. Fauvel 1923, p. 337, fig. 129 *e–m*.
Neries callaoana (non Grube) Augener 1918, p. 174 (partim).

Records: SH.71(1).

Notes: The specimen is typical. Though known from the Natal coast it has not been recorded from the Cape. The present record is from the hull of a ship from India. Augener's 4 specimens from Swakopmund labelled *N. callaoana* (V.8782) were kindly sent to me by the Director of the Hamburg Museum. Three proved to be *N. falsa* and one *Platynereis dumerilii*.

Nereis (*Nereis*) *eugeniae* (Kinberg) 1866

Nereis eugeniae. Ehlers 1897, p. 67, pl. 4, figs. 94–105. Monro 1936, p. 136.

Records: TRA.74(1), 80(3).

Notes: The anterior part of the prostomium is free from the bases of the palps; the eyes are small and the tentacles are short. The dental formula of the largest specimen is: I is 0; II is 3–4 in a line; III is 0; IV is 8–9 in a single to double row; V is 0; VI is a transverse group of 3; VII and VIII consist of 4

widely separated points in a single row. All paragnaths are minute and as shown they are not numerous in these small specimens.

Anterior feet have two dorsal lobes. In the posterior feet all lobes are pointed and the dorsal lobe is much larger than the rest. By contrast the dorsal cirrus is thin and delicate. Most posterior notopodia include 1–2 stout homogomph falcigers with very short conical blades hardly longer than the width of the shaft. Ventral falcigers of anterior feet have long straight blades; in posterior feet there are fewer but larger ones.

Nicon eugeniae was first described by Kinberg from a specimen collected off Argentina opposite the Rio de la Plata. Most workers however refer to the description given by Ehlers (1897) for *Nereis eugeniae* based on specimens collected in the Magellan area and compared with Kinberg's type. It is significant that neither author refers to homogomph falcigers in the posterior notopodia, and that Ehlers describes and figures the tentacular cirri of his specimen as being annulated and says that the tentacular cirri of Kinberg's specimen were '*gegen die Spitze hin deutlich gegliedert*'.

I have examined specimens in the British Museum identified by Monro (1930) and (1936) as *Nereis eugeniae*. None of these show annulated tentacular cirri and all have homogomph falcigers with short conical apices in the posterior notopodia. They are identical with my South African material. Kinberg's types must be examined before the identity of Monro's specimens and mine can be firmly established.

N. eugeniae is closely related to *N. trifasciata* Grube 1878 from the Phillipines. In the original description there was again no reference to homogomph falcigers in posterior notopodia but Augener (1922) who states that he was not able to see Grube's type, describes *N. trifasciata* from Juan Fernandez Island as having notopodial falcigers in posterior feet with long, almost straight blades some 4–5 times as long as the width of the shaft. Fauvel (1932) refers to similar setae in his description of material from the Indian Ocean. Here again the type must be examined before the naming is certain, but it will be obvious that the main difference between *N. eugeniae* (*sensu* Monro 1936) and *N. trifasciata* (*sensu* Augener 1922) lies in the structure of the notopodial falcigers.

Nereis (*Nereis*) sp.

(Fig. 8*a*)

Records: TRA.62(1).

Notes: The material consists of a single complete specimen 8 mm. long with 40 segments. The prostomium is broadly rounded in front and the palps are large with small palpostyles; the tentacles are normal and rather short. There are no colour markings. The dental formula is I = 1; II is a wedge of close-set points; III is a few scattered points; IV is like II; V = 0; VI is a rosette of 8–10 points; VII and VIII is a continuous band consisting of 2–3 irregular rows.

Anterior feet have two notopodial lobes. In posterior feet the superior notopodial lobe is enlarged and flattened and carries the cirrus at its apex; the inferior notopodial lobe is a slender cone.

Anterior notosetae are homogomph spinigers with short blades. Anterior neurosetae include homogomph spinigers with short blades and heterogomph spinigers. In middle feet there is a gradual change in the setae; the notopodial spinigers decrease in number and some of the neuropodial falcigers lose the articulation between shaft and blade. In posterior feet the notosetae include 2–3 homogomph falcigers with long straight blades and the neuropodial setae include 1–2 stout simple hooks (fig. 8*a*) formed by fusion of the straight pointed blade with the shaft, 2–3 normal heterogomph falcigers with fairly straight blades and 1–2 fine homogomph spinigers.

As far as I can ascertain no species with similar setae has been described but the single specimen is a juvenile of 8 mm. and for this reason is not named as a new species.

Nereis (*Neanthes*) *caudata* (Delle Chiaje) 1841

?*Nereis cricognatha* Ehlers. Augener 1913, p. 163. Knox 1951, p. 217, pl. 45, figs. 6–8.
Nereis (*Neanthes*) *caudata*. Fauvel 1923, p. 347, fig. 135 *a–e*. Day 1953, p. 425.

Records: LB.161(1); SH.204(1), 366(1); MB.16(4).

Notes: After studying the descriptions of Augener (1913) and Knox (1951) I see no reason why *N. cricognatha* Ehlers (1905) from New Zealand should not be included in the synonymy of *N. caudata.*

Perinereis capensis (Kinberg) 1865

Perinereis capensis. Monro 1933, p. 495, figs. 7–11. Day 1934, p. 42, figs. 8 *a–e*.

Records: SB.177 (1 juvenile); FAL.80(p), 122(p), 127(1), 159(2), 171(2), 174(1), 245(1); MB.9(1), 13(1), 16(2), 20(2), 40(4), 49(21), 53(18), 56(2), 62(1), 67(2), 74(2), 78(1), 85(1); LIZ.1(1), 6(4), 18(fc), 27(4).

Pseudonereis variegata (Grube) 1856

Nereis (*Mastigonereis*) *variegata* McIntosh 1904, p. 37, pl. 1, figs. 6–10.

Records: FAL.126(1); TRA.69 (1 swimming in plankton).

Notes: This species which is so common between the tide marks has only been found on one occasion below low water.

Platynereis dumerilii (Aud. and M.-E.) 1833

Platynereis dumerilii. Fauvel 1923, p. 359, fig. 141 *a–f*. Day 1953, p. 429.

Records: Lamberts Bay 14 records from 10-23 metres on rock (common); SB.114(c), 116(c), 122(p), 127(2), 129(3), 136(1), 180(8), 181(2), 183(3), 184(2), 194(4), 195(c); LB.155(c), 160(5), 161(4), 190(2), 380(4); SH.74(1);

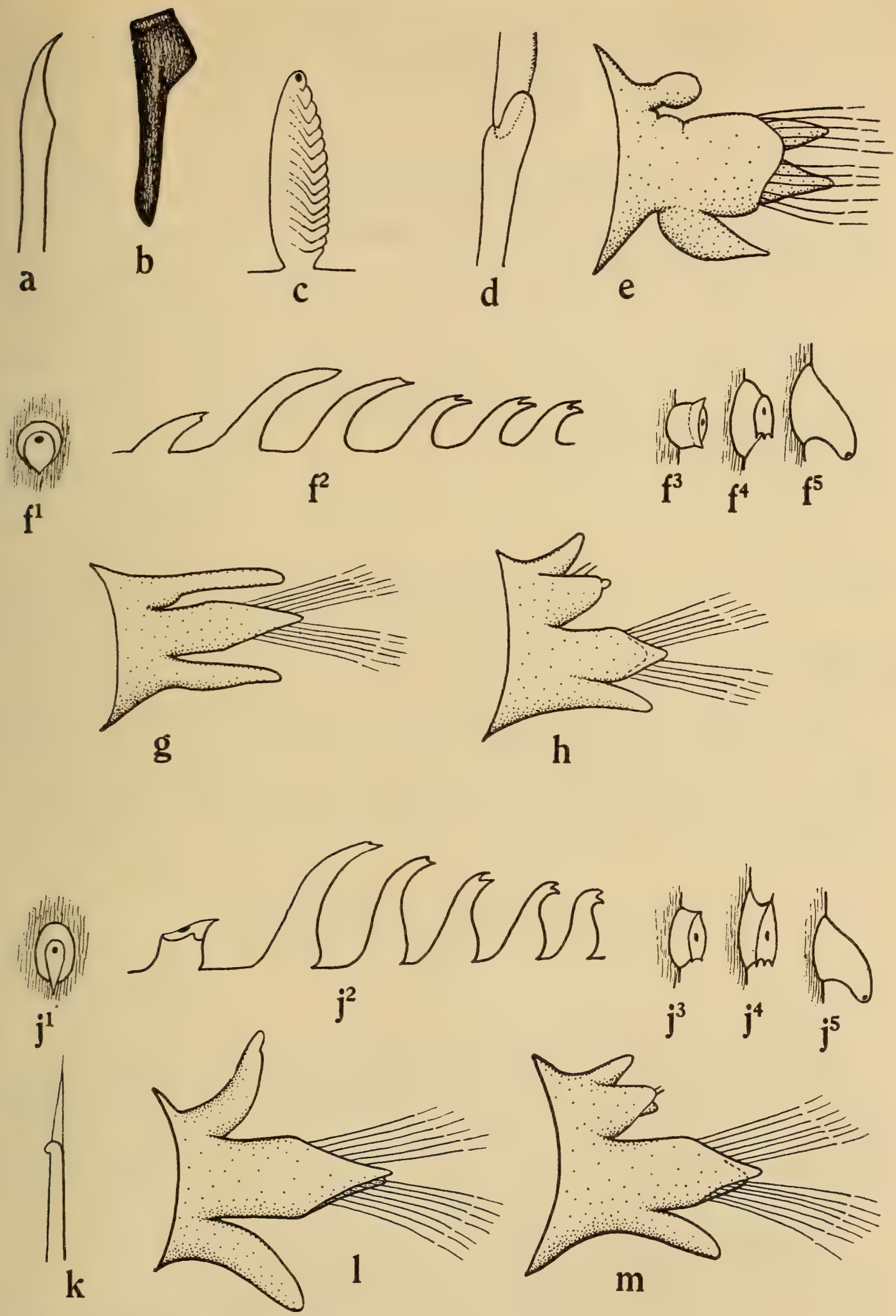

FIG. 8. *Nereis* sp.: *a* simple seta from posterior neuropodium.

Glycera benguellana: b jaw support; *c* papilla from proboscis; *d* head of compound seta; *e* posterior view of foot.

Glycinde capensis: f^{1-5} proboscidial papillae (f^1 plan view of row *l*, f^{2-5} lateral view of rows 2–5); *g* anterior view of anterior parapodium; *h* anterior view of posterior parapodium.

Glycinde kameruniana: j^{1-5} proboscidial papillae (j^1 plan view of row, *l*, j^{2-5} lateral view of rows 2–5); *k* notoseta of posterior foot; *l* anterior view of anterior foot; *m* anterior view of posterior foot.

TRA.69 (abundant in plankton); TRA.107(1); False Bay: 33 records from 0–36 metres on Algae or hydroids; (MB.4(1), 20(2), 27(4), 38(1), 40(6), 56(8), 59(1), 74(13), 86(2), 87(2); LIZ.1(2), 6(6), 13(1), 27(4); SCD.20(1).

Platynereis australis (Schmarda) 1861

Platynereis magalhaensis Kinberg. Fauvel 1916, p. 434, pl. 8, figs. 21, 22.
Platynereis australis Day 1953, p. 429.

Records: SB.130(7); LB.155(1), 472(3); SH.366(1); 415(1).

Platynereis calodonta Kinberg 1866

Platynereis hewitti Day 1934, p. 44, fig. 9 *a–f*.
Platynereis calodonta Day 1953, p. 429.

Records: FAL.134(1); MB.40(1); LIZ.6(1), 27(1).

Family *SPHAERODORIDAE*

Ephesia gracilis Rathke 1843

Ephesia gracilis. Fauvel 1923, p. 377, fig. 148 *a–f*.

Records: LAM.8(2), 31(1), 54(1), 59(2); SB.119(1), 183(1); TB.305(1), 330(1); TRA.58(1), ?102(3), 143(2); FAL. 223(1), 371(1), SCD.54(1).

Notes: This is a new record for South Africa and the specimens have been checked as identical with European material.

Family *NEPHTHYDIDAE*

Nephthys (*Nephthys*) *capensis* Day 1953

Nephthys (*Nephthys*) *capensis* Day 1953, p. 431, text fig. 5 *g–m*.

Records: LAM.52(3); LB.364(5); FAL.107(1), 209(1); TRA.104(1).

Notes: In these larger dredged specimens the gills are often cirriform throughout so that there is a strong superficial resemblance to *N. hombergi*. However, it lacks a bilobed presetal lamella having at most a rudimentary presetal lamella in the notopodium, and always has short, saw-edged geniculate setae in the posterior row as well as the usual elongate capillaries.

This species is close to *N. gravieri* Augener (1913) from Fremantle, and may indeed be identical. However, Augener's figures of the anterior setae, the shape of the parapodial lamellae and the gill suggest that there are important differences. Moreover, he only mentions two types of setae and gives the impression that there are only saw-edged geniculate setae in the posterior row.

Nephthys (*Nephthys*) ? *paradoxa* Malmgren 1874

Records: AFR.1578(1).

Notes: The material consists of the anterior half of a large worm. The prostomium is pentagonal with 4 subequal antennae and a pair of colourless eyes. The proboscis has 22 rows of papillae with 5–6 papillae per row. The ventral cirrus of setiger 1 is a little shorter than the antennae and the dorsal cirrus shorter still. Branchiae first appear on setiger 9 as foliaceous organs but become stout and cirriform towards the end of the fragment.

In anterior feet the notopodium has an oval setigerous lobe, a rudimentary presetal lamella and a rounded posterior lamella a little larger than the setigerous lobe. The gill is flattened and bears a small dorsal cirrus. The neuropodium has a bluntly conical setigerous lobe, a rudimentary presetal lamella and a rounded postsetal lamella only slightly larger than the feet. The ventral cirrus is normal. Later feet are essentially similar with slightly more divergent and pointed rami.

Anterior setae are normal laddered capillaries and posterior setae are long and bear transverse bands of conical teeth. These are deciduous and where they have dropped off transverse marks are left.

More material is required before this determination can be confirmed.

Nephthys (*Nephthys*) *hombergii* Savigny 1818

Nephthys hombergii. Fauvel 1923, p. 367, fig. 143 *a–d*. Day 1953, p. 431.

Records: SB.184(3), 202(8), 203(13), 205(1); LB.300(c), 391(2); TRA. 85(1); TB.301(1); WCD.15(6), 19(3), 21(7), 23(1), 28(6); FAL.187(2), 341(5), SCD.25(1), 63(8), 109(1).

Nephthys (*Nephthys*) *tulearensis* Fauvel 1919

Nephthys tulearensis Fauvel 1919, p. 422, pl. 16, figs. 31–39.

Records: MB.81(1).

Nephthys (*Micronephthys*) *sphaerocirrata* Wesenberg-Lund 1949

Nephthys sphaerocirrata Wesenberg-Lund 1949, p. 294, figs. 24-26. Day 1953, p. 431.

Records: SB.175(1), 199(2), 202(4), 203(16), 205(2); LB.323(1); WCD. 15(16), 19(20), 21(38), 23(18), 26(14), 28(12); FB.316(2); FAL.229(1), 250(2), 328(3), 338(1), 352(3), 375(7), 376(3), 378(3); LIZ.25(2); SCD.82(2), 109(3).

Nephthys (*Aglaophamus*) *macroura* Schmarda 1861

Aglaophamus macroura Hartman 1950, p. 118.

Records: AFR.783(1); AFR.1578(1); SCD.9(4).

Notes: These specimens agree very well with Hartman's description with the exception that the branchiae start on setiger 2 not 3 or 4 as stated. It might

also be added that the presetal lamella (not described by Hartman) is bilobed. The lamella is well developed in the first few feet but soon becomes reduced. It disappears in the notopodia but in the neuropodia minute lobes persist above and below the setigerous lobe.

Family *GLYCERIDAE*

Glycera convoluta Keferstein 1862

Glycera convoluta. Fauvel 1923, p. 383, fig. 150 *h–n*.

Records: LAM.45(2), 49(1), 52(4); SB.125(8), 175(1), 177(14), 179(1), 183(1), 184(2), 189(6), 193(1); LB.158(6), 159(10), 160(2), 169(1), 239(5), 299(c), 300(c), 363(4), 364(6), 380(c), 382(c), 391(6), TB.301(1); AFR. 1224(1); TRA.77(c), 143(1); WCD.15(5), 19(4), 21(4), 23(5), 26(1), 28(9); FB.323(7), 330(1); FAL.58(1), 187(1), 205(1), 209(1), 219(1), 225(1), 226(1), 240(9), 241(1), 243(1), 338(1), 341(c), 345(3), 347(2), 376(1), 378(2); KNY. 61(1); LIZ.24(1).

Glycera alba Müller 1788

Glycera alba. Fauvel 1923, p. 385, fig. 150.

Records: TRA.108(2).

Notes: The first gill is on setiger 33. I doubt very much whether this species is really separate from *G. convoluta*.

Glycera parashadi Fauvel 1932

Glycera parashadi Fauvel 1932, p. 126, pl. 5, figs. 1–8. Day 1957, p. 86.

Records: FB.317(1); FAL.211(1), 245(1).

Glycera unicornis Savigny 1818

Glycera unicornis. Fauvel 1923, p. 389, fig. 153 *e–i*. Day 1953, p. 430.

Records: AFR.935(1); TRA.27(1), 91(1); FB.323(3); FAL.117(1), 229(1), 341(1); LIZ.24(1); SCD.18(1).

Glycera papillosa Grube 1857

Glycera papillosa. Kinberg 1857–1910, p. 58, pl. 21, fig. 3. Augener 1922, p. 203, text-fig. 9 *a–c*.
?*Glycera kerguelensis* McIntosh 1885, p. 344, pl. 35A, figs. 3-4.

Records: FB.307(1); MB.74(1); LIZ.25(3), 38(1).

Notes: The prostomium has about 8 rings; the proboscidial papillae include a few ovoid forms, but the majority are slenderly conical, being five times as long as the basal breadth; they are not ringed. The jaw supports are deeply forked, the shorter limb being almost half the length of the longer one. There are no gills. The superior presetal lobe is minute but the inferior presetal lobe

is large and pointed. There is a single, broadly rounded post-setal lobe which reaches the same height as the ventral cirrus.

This species has longer proboscidial papillae and a much smaller superior presetal lobe than *G. capitata*.

It has been suggested that *Glycera kerguelensis* McIntosh 1885 is identical with *G. papillosa* and as Augener (1922) says, the description and figures of the proboscidial papillae agree very well. The type now in the British Museum has had its head cut off but the remainder of the worm shows that the original was much larger than Augener's specimen or mine. In the feet the superior presetal lobe is much smaller than the inferior one but not quite so minute as in the present specimens. Otherwise the feet are very alike. *G. kerguelensis* is certainly much closer to *G. papillosa* (type locality Valparaiso, Chile) than it is to *G. capitata* (type locality Denmark).

Glycera benguellana Augener 1931
(Fig. 8 *b–e*)

Glycera capitata v. benguellana Augener 1931, p. 303, text-fig. 9.

Records: LAM.26(2), 35(2), 40(2), 41(3), 49(1), 52(1); TB.304(1), 322(1); FAL.51(1), 63(1), 65(1), 206(1), 209(1), 233(3), 250(1); 349(1), 365(1), 378(1); MB.62(1); SCD.109(1).

Notes: The body is tapered at both ends, slightly swollen anteriorly and the segments are biannulate. The prostomium is very long with numerous (?30) indistinct rings. There are no visible eyes. The jaw supports (fig. 8*b*) have only one fork developed, the other limb being reduced to a mere expansion of the base. The proboscidial papillae include numerous elongate forms (fig. 8*c*) with 14–16 distinct V-shaped marks on one side and a few stout forms which are essentially similar in structure. The parapodium (fig. 8*e*) has a fairly large dorsal cirrus, two subequal presetal lobes, a single low rounded postsetal lobe and a broad pointed ventral cirrus. There are no gills.

As shown above this species is quite distinct from *G. capitata* in the shape of the jaw supports, proboscidial papillae and even the feet for the superior presetal lobe of *G. capitata* is distinctly smaller than the inferior one. Augener's record was from deep water off South West Africa but the present records show that it is common all round the Cape.

Glycera longipinnis Grube 1878

Glycera longipinnis. Fauvel 1932, p. 125, pl. 4, figs. 11–14.

Records: FAL.211(1).

Notes: The prostomium has about 12 poorly marked rings and rather long terminal antennae. There are no visible eyes. The proboscidial papillae are elongate and conical but not ringed. Gills start on the 20th setiger as simple

filaments arising from the dorsal edge of the foot at the same level as the presetal lobes. The gill filament is longer than the presetal lobes. The dorsal cirri are relatively large and arise from the body wall well above the foot in anterior segments but just at the base of the foot in the posterior part of the body. There are two long presetal lobes with pointed ends, and the superior one is distinctly shorter than the inferior. There is only one low rounded postsetal lobe; the ventral cirrus is short and pointed.

This is a new record for South Africa.

Glycera rouxii Aud. & M.-E. 1834

Glycera sagittariae McIntosh 1885, p. 346, pl. 42, fig. 8; pl. 22A, fig. 10.
Glycera rouxii. Fauvel 1923, p. 389, fig. 153 *a–c.*
Glycera goesi Malmgren, McIntosh 1925, p. 69.

Records: TRA.80(3), ?27(1); FAL.237(3).

Notes: The proboscidial papillae are simple blunt cones some of which show a trace of two rings. There are also a few spherical papillae. The jaw supports lack one prong of the complete Y shape. Branchiae start on the 18th foot as long, single, retractile filaments arising from the anterior face of the parapodium. There are two, unequal, pointed postsetal lobes, the superior being slightly longer.

An examination of the type of *Glycera sagittariae* McIntosh 1885 which is now in the British Museum shows that it has feet with single retractile gill filaments arising from the anterior face of the parapodium and that the postsetal lobes are triangular, the superior one slightly longer than the inferior. Both postsetal lobes are shorter than the presetal ones.

Fauvel (1932) has recorded *G. sagittariae* but his description and figures do not agree with the type specimen seen by me. Also McIntosh's pl. 42 fig. 8 shows no gill on the dorsal edge of the foot, and his remark that the gill arises 'from the upper and anterior part of the foot' agrees with his specimen. Hartman (1950) suggests that Fauvel's specimen is really a *G. tesselata*, but *G. tesselata* lacks gills. It differs in the proboscidial papillae from *G. alba* or *G. prashadi.* Hartman suggests that *G. sagittariae* McIntosh is *G. gigantea* but this is incorrect, since the latter has globular gills and rounded postsetal lobes.

Ophioglycera eximia (Ehlers) 1900

Goniada eximia Ehlers, Monro 1936, p. 141, fig. 25 *a–j.*
Ophioglycera eximia Hartman 1950, p. 38.

Records: AFR.1579(1); FAL.233(1).

Notes: These specimens are identical with Monro's specimens in the British Museum. The largest specimen has 4–5 teeth on the macrognaths, 30 dorsal and 19 ventral micrognaths. Parapodia 1–57 are uniramous with a dorsal cirrus which is notched on the dorsal edge; at the 58th foot the dorsal cirrus is

accompanied by a smaller inferior lobe; on the 60th notosetae appear between these two lobes and on succeeding feet the inferior notopodial lobe grows larger and by the 70th the two lobes are equal in size.

This is a new record for South Africa.

Glycinde capensis n. sp.
(Fig. 8 *f–h*)

Records: FB.306(1), 316(2); FAL.209(2), 250(1), 375(1 juv.); MB.81 (1 juv.); SCD.61(1), 63(1), 82(1).

Description: The holotype is the largest of the six incomplete specimens from False Bay and comes from FB.306. It measures 40 mm. for 112 segments and is pale yellow in alcohol. The tapered prostomium is 8-ringed with 2 pairs of eyes and 4 minute terminal antennae. The basal pair of eyes is internal and the distal pair just below the terminal antennae, is external. The long proboscis is covered with the usual rows of papillae and is armed with a pair of ventral macrognaths each with 5 teeth and a dorsal ring of 24 micrognaths (one of the paratypes has only 15).

According to Hartman's formula the proboscidial papillae (fig. 8*f*) consist of 6 groups. Group I which lies along the median dorsal line is formed by a sparse double row of minute tubercles each with a single point (fig. 8f^1). Group II (fig. 8f^2) consists of 6 oblique rows of much larger tubercles running along the dorso-lateral surface. II*a* the (dorsalmost) is small and the apex of each tubercle ends in 2 points. II*b* and II*c* are the largest and each tubercle is curved with a single apical point. II*d*, *e* and *f* decrease in size and the apex of each ends in two points like the open beak of a bird. Group III (fig. 8f^3) consists of a row of minute, oval tubercles each ending in double points. Group IV (fig. 8f^4) is a row of slightly larger tubercles, each with a 3-pointed apex. Group V (fig. 8f^5) is a row of large, soft, bluntly conical papillae each with a small pore at the apex. Group VI, as usual, is absent.

The anterior region of the body consists of 28 uniramous segments, each with a straplike dorsal cirrus (fig. 8*g*), a compressed and tapered setigerous lobe and a ventral cirrus similar in shape to the dorsal but a little shorter.

All along the length of the body there is a tendency for the parapodial lobes to become shorter and broader and for the ventral cirrus to be attached more distally. This is true both for the anterior as well as the posterior region. Moreover, the rudiment of what, in the posterior region behind segment 29 will become the notopodium becomes evident about the 20th segment as an inferior thickening and later expansion of the dorsal cirrus. The setigerous lobe consists of the fused presetal and postsetal lobes with the setae issuing as superior and inferior fans.

The posterior, biramous region starts at setiger 29. Here, as the notopodium develops, the dorsal cirrus becomes shorter and moves into a postero-dorsal

position while an anteroventral lobe grows out and soon reaches the same size. The notosetae issue from a slit between them. The neuropodium is homologous with, and essentially similar to, the setigerous lobe and ventral cirrus of the anterior region. A typical foot of the posterior region (fig. 8*h*) has a broadly triangular notopodium with a small flattened dorsal cirrus and a larger but still essentially triangular neuropodium with a ventral cirrus.

In the anterior region the setae are all compound with spinigerous blades. In the posterior region, the notosetae are 2–3 acicular setae with bluntly hooked ends protected by a spike-like guard. The neurosetae are similar to the setae of the anterior region.

The South African material is obviously close to *G. nordmanni* (Malmgren) and *G. wireni* Arwidsson. However both of these are northern forms, the type locality of the former being Norway and of the latter, the Behring Straits.

Moreover there are several small differences from both these species. *G. nordmanni* has 36–37 anterior segments and examination of several specimens of various sizes in the British Museum showed that this figure is surprisingly constant. *G. wireni* has 31 anterior segments, only a single pair of eyes at the base of the prostomium and few (17) micrognaths. It seems safer to distinguish the South African material as a separate species until more is known about the variation and distribution of these rather rare worms.

Glycinde kameruniana Augener 1918

(Fig. 8 *j–m*)

Glycinde kameruniana Augener 1918, p. 398, pl. 4, fig. 93; pl. 7, fig. 211.

Records: FAL.237(1), 341(1), 375(1); SCD.109(4).

Description: As far as I am aware this species has not been recorded since Augener's original description of a 10 mm. ovigerous female from the Cameroons in tropical West Africa. Augener's description is very incomplete and his figures add nothing to the text. For this reason a full description of the South African specimen is given below.

The specimen dredged in False Bay is a complete, ovigerous female measuring 39 mm. with 100 segments. It is pale in alcohol.

The prostomium has 8 indistinct rings, 4 minute terminal antennae and a pair of eyes embedded in the basal ring. A distal pair of eyes is lacking. The proboscis has a pair of ventral macrognaths each with 4 teeth and a dorsal arc of 4 micrognaths. The papillae on the proboscis (figs. $8j^{1-5}$) are of the usual type. Those of the mid-dorsal row (group I (fig. $8j^1$) are minute oval tubercles with a single point. Group II (fig. $8j^2$) is a dorsolateral band formed of 5 large falcate tubercles in oblique rows; II*a* is small, stout and has a single point; II*b* is very large, with a curved single-pointed tip; II*c* is similar but the tip is not so sharp and II*d* and *e* are progressively smaller and have two points curved like the open beak of a bird. Group III (fig. $8j^3$) is a row of minute

tubercles each with 3 points. Group IV (fig. $8j^4$) is a row of slightly larger tubercles whose oblique tops have 3 points dorsally and a sort of prow ventrally. Group V (fig. $8j^5$) is as usual, a row of large soft papillae with faintly bilobed apices.

The anterior uniramous region consists of 21 segments. Each parapodium (fig. 8*l*) consists of a strap-like dorsal cirrus, a setigerous lobe with a single tapering presetal lobe, a similar, subequal postsetal lobe and a ventral cirrus essentially similar to the dorsal one. The first few parapodia (e.g. the 8th) have the dorsal cirrus as a simple strap but from about the 15th it becomes obvious that the inferior side of the cirrus is bulging so that such dorsal cirri could conceivably be described as having a notch below the tip.

In the posterior region the body is a little flatter and the biramous parapodia are relatively larger. The notopodium, formed as a ventral outgrowth from the dorsal cirrus, is at first a simple bilobed structure but further back the dorsal cirrus becomes relatively shorter and posterodorsal in position. The setigerous lobe itself develops a minute second lobe (see fig. 8*m*) The neuropodium remains essentially similar to the setigerous lobe of the anterior region but here it is evident that the presetal lobe is distinctly longer than the postsetal lobe.

The setae are of the usual types. In the notopodium there are usually 2 acicular setae (fig. 8*k*) with bluntly curved apices and pointed guards. The setae of the anterior region and those of posterior neuropodia are slender-bladed spinigers. I have not been able to see the detail given by Hartman (1950).

The above description agrees with Augener's brief account in regard to the number of anterior segments, setae, shape of parapodia and eyes. Of the micrognaths he says he was only able to see '*einige ganz feine schwarze Punktchen*'. . . . I take this to mean that there were only a few micrognaths. Augener gives no account of the proboscidial papillae.

G. solitaria (Webster) from the Atlantic coast of U.S.A. has been redescribed by Hartman (1950) and is obviously close to the present material. The number of anterior segments is a little larger (24), a distal pair of eyes is present and there are more micrognaths (10). On the other hand the papillae on the proboscis seem generally similar though groups IV and V are a little different. The parapodia are very alike. It is possible that further collecting on the tropical West African coast will show that *G. kameruniana* is a synonym of *G. solitaria*.

Goniada maculata Oersted 1843

Goniada maculata. Fauvel 1923, p. 392, fig. 154 *a–g*. Hartman 1950, p. 20, pl. 1, figs. 7–8.

Records: WCD.5 (1 juv.), 26(1 juv.); TRA.110(1 juv.); FAL.240(3), 250(1), 352(1).

Notes: South African specimens are quite typical. The papillae on the proboscis are as figured by Hartman and the feet agree with Fauvel's figures. In juvenile specimens it was noted that while the number of micrognaths

remains 3–4 dorsally and 3–4 ventrally, the number of teeth on the macrognaths may be as low as 4; again the change in the parapodial structure occurs a little earlier, on the 35th as against the 39–41st foot as usually quoted. Specimens of all sizes lacked eyes and from the 30th foot on, where there are two fingerlike presetal lobes to the neuropodium, the superior one is always a little longer than the inferior one.

Family *EUNICIDAE*

Subfamily Eunicinae

Eunice vittata (Delle Chiaje) 1828

Eunice vittata. Fauvel 1923, p. 404, fig. 158 *h–n*. Day 1953, p. 433.

Records: AFR.691(p), 801(p), 994(p); TRA.56(p), 58(p), 71(a), 152(p); FB.302(1); FAL.26(1), 29(1), 184(1), 223(2), 243(1), 328(3), 334(7), 338(1), 341(1); MB.9(2), 67(4), 78(1); LIZ.18(4); SCD.22(1), 82(1), 99(3), 100(4), 109(3).

Eunice floridana (Pourtales) 1869

Eunice floridana. Fauvel 1923, p. 402, fig. 157 *a–g*.

Records: AFR.761(1), ?773(1), 775(1).

Eunice pennata (Müller) 1776

Eunice antarctica Baird 1869.
Eunice savignyi (non Grube) Ehlers 1908a, p. 88, pl. 11, figs. 7–13. Hartman 1956, p. 283.
Eunice pennata. Fauvel 1923, p. 400, fig. 156 *h–o*. Monro 1930, p. 118, fig. 42.
Leodice langi Treadwell 1943, p. 3, figs. 14–18.

Records: AFR.691(1), 707(1); TRA.115(1); FAL.375(2).

Notes: Baird's type of *Eunice antarctica* from 'Antarctic seas' which is in the British Museum has been compared with *E. pennata* from Europe identified by Fauvel and *E. pennata* from Tristan de Cunha identified by Monro (1930) and the present material from South Africa. All are identical. Baird states that in *E. antarctica* the gills start on the 8th foot, but examination of the type shows that there are small single filaments from the third foot. *E. pennata* has fairly short tentacles with faintly marked annulations towards the tip. It is close to *E. savignyi* Grube from the Philippines but the latter is a tropical shallow water species with distinctly jointed or even moniliform tentacles. Moreover in *E. savignyi* the median tentacle is very long and reaches the 16th setiger whereas in *E. pennata* it only reaches the 3rd to 8th foot. Ehlers's record of *E. savignyi* from the Agulhas Bank obviously refers to *E. pennata*.

By the courtesy of the U.S. National Museum I was able to examine Treadwell's type of *Leodice langi* collected by H. Lang from 160 fathoms off Cape Town. The material, Ref. No. A6099, consists of a single specimen from which the jaws have been removed. The gills begin on the 3rd setiger as simple filaments, reach a maximum of 8 filaments on the 15th foot and end on

the 37th foot. The setae also agree with those of *Eunice pennata*. Hartman (1956) has referred Treadwell's *Leodice langi* to *E. savignyi* following Ehlers's record as cited in Fauvel (1932).

Eunice aphroditois (Pallas) 1788

Eunice rousseaui Quatrefages, Fauvel 1923, p. 403, fig. 158 *a–g*.
Eunice aphroditois Day 1943, p. 432.

Records: LB.157(2), 161(1), 299(c); FAL.51(1), 159(1); LIZ.35(1).

Eunice australis Quatrefages 1865

Eunice australis. Fauvel 1932, p. 139. Day 1953, p. 432.

Records: TRA.135(5), 152(p); FAL.30(1), 302(1), 334(2); MB.49(1), 67(1); LIZ.18(1); SCD.9(1), 32(2), 40(4), 54(3), 58(1), 89(9).

Marphysa sanguinea (Montagu) 1815

Marphysa sanguinea. Fauvel 1923, p. 408, fig. 161 *a–h*.

Records: LB.299(fc).

Marphysa capensis (Schmarda) 1861

Marphysa capensis. Augener 1918, p. 332, text-fig. 33.

Records: TB.318(4).

Marphysa depressa (Schmarda) 1861

Marphysa depressa. Day 1953, p. 434, fig. 5 *n, p*.

Records: LB.299(fc), SCD.63(1).

Marphysa purcellana Willey 1904

Marphysa purcellana Willey 1904, p. 263, pl. 13, fig. 17. Day 1953, p. 435.

Records: FAL.219(1), 223(1); MB.20(1); LIZ.18(1); SCD.58(1).

Notes: This is the second record of this rare species. The head and anterior segments are reddish brown and the falcigerous setae have long blades.

Marphysa sp.

Records: LIZ.35(1).

Notes: A single specimen of *Marphysa* which is new to South Africa was dredged in Algoa Bay (LIZ.35.T). It is 20 mm. long by 0·6 mm. with about 100 segments. The tail end is missing. This small, slender worm may be a juvenile and for this reason is not described as a new species.

The diagnostic characters are as follows: Prostomium bilobed, eyes present, antennae faintly annulated, a little longer than the prostomium. Gills appear far back (approximately the 60th setiger) and never develop more than a single filament. Setae include superior capillaries and inferior bidentate falcigers in all feet. Posterior feet have in addition comb-setae with about 12 teeth and bidentate acicular setae with guards. The acicula are bluntly pointed and all setae and acicula are pale.

Lysdice natalensis (Kinberg) 1865

Lysidice capensis Grube, McIntosh 1905, p. 40, pl. 3, fig. 13.
Lysidice natalensis Day 1951, p. 40. Day 1953, p. 435.

Records: AFR.967(1); FAL.16(4), 21(p), 44(3), 80(p), 113(p), 122(p), 126(1), 134(1), 156(2), 219(1), 269(1), 371(1); MB.49(1), 56(2), 67(1), 78(1); LIZ.6(1), 18(1), 27(1); SCD.89(1).

Subfamily Onuphidinae

Onuphis emerita Aud. & M.-E. 1834

Onuphis emerita. Fauvel 1923, p. 415, fig. 163. Monro 1930, p. 128, fig. 47.

Records: TRA.41(3); FB.321(3); FAL.205(2), 211(1), 228(2), 238(7), 242(4), 341(3), 352(2); MB.67(1), 81(1); LIZ.19(1), 24(1), 31(2 juvs.); SCD.96(1).

Notes: The specimens recorded above vary from juveniles of 25 mm. (LIZ.31) to well-grown individuals of 75 mm. They agree very well with Fauvel's description. Some individuals are pale but others have well-developed brown pigment pattern identical with that on preserved specimens from Naples now in the British Museum.

This species was first described from South Africa by Monro (1930) but his account is slightly inaccurate. I have checked his specimen from False Bay (British Museum No. 1930.10.8.1792) and find that the 'little conical tubercle' which he states is restricted to the first 3 or 4 setigers is actually the setigerous lobe. The structure which Fauvel 1923, p. 415 and fig. 163. *C*, calls '*un petit tubercle conique entre le mamelon sétigère et la base du cirre dorsal*' is a superior projection of the presetal lobe. This is well marked on the 5th–10th foot on a 100 mm. specimen from Naples but is not present on the smaller 23 mm. specimen described by Monro nor on the present material.

Onuphis (*Nothria*) *holobranchiata* Marenzeller 1879

Onuphis (*Nothria*) *holobranchiata.* Izuka 1912, p. 106, pl. 11, figs. 10–12.

Records: LAM.11(5), 26(5), 35(2), 39(c), 40(2), 41(2); LB.382(7); TRA.110(1), 113(1), 135(1), 143(3); FAL.375(5), 376(c), 378(3).

Notes: Most of the specimens were broken but the average size when complete was probably 4–5 cm. Only faint traces of pigment remain between

the parapodia and some worms are completely pale. Eyes are present just external to the inner lateral occipital antennae. The ceratophore of the median antenna has 10–12 rings but the other antennae are longer and have ceratophores with about 14 rings. The jaws are weakly chitinized and the formula starting with the main fangs is Mx.I = 1 (left) + 1 (right); Mx. II = (5–7) + (6–8); Mx. III = (6–7) + 0; Mx. IV = 7 + 10; Mx. V = 1 + 1. The tentacular cirri are slightly longer than the peristomial segment.

The dorsal cirrus is cirriform throughout. Gills are present as a single filament on the first and all succeeding feet to near the posterior end of the body. As usual the first 5 feet have a cirriform ventral cirrus, and a prominent setigerous lobe and a cirriform 'post-setal lobe'. From the 6th foot onwards the ventral cirrus is represented by a glandular pad, the setigerous lobe becomes inconspicuous and a presetal swelling appears, though the presetal lobe is never well marked. The 'post-setal lobe' diminishes in size and from about the 20th foot it is an inconspicuous conical projection of the foot partially enclosed by a dorsal arc of setae. This seems to be what usually happens in the Onuphidinae.

The first 5 feet bear about 6 pseudocompound setae with bivalve hoods. These setae are all tridentate but the third tooth may be so minute that unless it is seen in profile, it may be thought to be absent. There are also 2–3 simple capillaries. On the 6th foot the pseudocompound setae disappear and the capillaries develop narrow wings. Two bidentate acicular setae appear in the 10th foot and 2 very fine comb-setae with about 18 teeth are present in the 20th foot although they may be present before this. An average foot from the middle of the body thus contains 2 pale acicula with very slender tips projecting from the surface, about a dozen narrow-winged capillaries, 2 fine comb-setae and 2 bidentate acicular setae.

O. holobranchiata first described from Japan has been recorded from the Indian ocean by Crossland (1904) and Fauvel (1930, 1932). The pseudocompound setae are variously described as bidentate and tridentate. Hartman (1944) has made a very thorough study of the Onuphidinae of the western hemisphere and under the name *Nothria* describes two species *N. elegans* (Johnson) and *N. iridescens* (Johnson) which, like *O. holobranchiata*, also have gills as simple filaments from the first setiger. She discusses the differences between the three species on p. 88.

Onuphis (Nothria) geophiliformis (Moore) 1903

Nothria geophiliformis Moore 1903, p. 445, pl. 25, figs. 57–59.
Onuphis geophiliformis Izuka 1912, p. 103, pl. 11, figs. 8–9.

Records: FB.311(10), FAL.219(1), 328(1 juv.).

Notes: All the specimens were broken but the largest was approximately 30 mm. long when complete. Most of the specimens are quite pale in alcohol,

but two show brown markings between anterior parapodia and one has the anterior dorsum uniformly brown. The tube is unknown.

Frontal antennae are ovoid, and the occipital antennae have ceratostyles 3–4 times longer than their ceratophores. The median antenna which reaches back to the 6th setiger has a ceratophore with 8–9 rings. Eyes are present external to the inner lateral ceratophores. The tentacular cirri are a little less than the length of the peristomial segment. The jaws are very pale and soft. The mandibles have the usual form and the maxillary formula is Mx. I = (left) 1 + (right) 1; Mx. II = 8 + 9; Mx. III = 8 + 0; Mx. IV. = 6 + 9; Mx. V = 1 + 1.

The parapodia are of the usual form. Gills as single filaments appear on the 4th or 5th setiger, and are always longer than the dorsal cirrus from whose base they arise. They persist over most of the body but are absent from the last 40–50 feet. Each of the first 5 feet has a prominent setigerous lobe but thereafter the setigerous lobe becomes reduced and is hidden between the presetal swelling and the cirriform post-setal lobe. The latter also decreases and at the 12th foot becomes a mere papilla partially encircled by setae. The ventral cirrus is a tapered cirriform organ for the first 5 feet but thereafter becomes a glandular pad and merges with the setigerous lobe at about the 15th foot.

The hooded pseudocompound setae of the first few feet are tridentate with the terminal tooth much longer than the second and third. The winged capillaries are simple, never compound. Hooded and bidentate acicular setae appear in the 9th–10th foot and 2–3 minute comb-setae with about 12 teeth further back.

The above description agrees well with that of Izuka except that he states that eyes are absent and comb-setae have 16 teeth. According to Moore (1911) and Hartman (1944), *O. geophiliformis* is distinguished from *O. pallida* Moore 1911 mainly by the shape of the pseudocompound setae. In the latter species the terminal tooth is no larger than the others.

Onuphis (*Nothria*) *conchylega* Sars 1835

Onuphis conchylega. Fauvel 1923, p. 415, fig. 164.

Records: TRA.33(1).

Genus Diopatra

Although *Diopatra* has been regarded as one of the most clearly defined genera of the *Onuphidinae*, distinguished by the spiral arrangement of the filaments on the branchial trunks and the possession of tentacular cirri, it is shown below in the discussion of *Diopatra dubia* that the separation of *Diopatra* from *Epidiopatra* is by no means simple. Moreover the question as to whether there is one species of *Diopatra* or several species is a matter of controversy. Important discussions will be found in Augener (1918), Fauvel (1933), Hartman (1944) and Rullier (1958). Augener divided the genus into two main groups of species

based on the number of teeth on the comb-setae. Fauvel who gives parallel lists of species with few or many teeth on the comb-setae from similar regions, concludes that there is one species with minor variations. Hartman used various characters to distinguish several species in the western hemisphere. Rullier agrees with Fauvel.

I have examined the South African material reported below and material in the British Museum which includes 30 samples labelled *Diopatra neapolitana* from various parts of the world and samples labelled with 10 other specific names. This has shown beyond doubt that there *are* several species and that the synonymy of *Diopatra neapolitana* in particular is very confused. However, once the diagnostic characters are recognized, the specific distinctions are fairly clear. The following characters seem to be of value.

Pigment pattern

While the intensity of the pigmentation varies from specimen to specimen and the fainter markings fade with age, the pattern is surprisingly constant and the more intense diagnostic marks have persisted in spirit in specimens of *D. neapolitana* collected in the last century.

Prostomial appendages

These are often called tentacles but are here referred to as antennae as they arise from the prostomium. The frontal antennae are presumable affected by the method of fixation but in one species at least (*D. dubia*) they are characteristic, shovel-like expansions while in others they are sausage-like or subulate. The ceratophores of the five occipital antennae are ringed and the number of rings seems to have a limited variation within a species e.g. 3–5, 6–8, 9–12, 15–20. In *D. dubia* and in *Epidiopatra hupferiana* the rings develop lateral projections so that the ceratophores may be said to be branched. Hartman (1944) has also drawn attention to 'glandular structures on antennae' but unfortunately she does not describe her methods of preparation, and the picture seen varies with the method used. However, if the clear cuticle is stripped from the ceratostyle, a number of depressions formed by oval cells will be found projecting into the thickness of the cuticle. These are usually arranged in 15–25 longitudinal rows or may be irregularly placed.

Jaws

Most workers are agreed that the maxillae are of no diagnostic value and though this may not be the case, there is variation both in the number of well-formed teeth and in the interpretation of what are teeth and what are not. Incidentally there is some confusion in the numbering of the maxillary plates since the left side has one more plate than the right. Dissection shows that Mx. IV (which are curved plates) correspond, also Mx. I (the main fangs), Mx. II and Mx. V, so that it is Mx. III which is missing from the right side. The mandibles too are usually disregarded, but in at least one species (*D. monroi* described below) the mandibular shafts are characteristically swollen.

Parapodia

These provide useful characters but the structure of the feet changes over the length of the body and the real nature of the different parts has not been realized. Thus in the first 4 feet, a presetal lobe is not developed, but the setigerous lobe which is oval and compressed has been called a presetal lobe. Further back in the branchiferous region, a true presetal lobe is formed and may be symmetrical or asymmetrical with a marked inferior projection. Towards the end of the branchiferous region the presetal lobe is again reduced to an insignificant swelling in front of the setae. In the anterior region there is what has become known as a cirriform postsetal lobe. This later decreases is size, fuses with the now insignificant setigerous lobe and becomes partially surrounded by a dorsal arc of setae—it becomes, in fact, a small conical setigerous lobe but for convenience, the term postsetal lobe will be retained for anterior feet, and in *D. chiliensis* it is quite characteristic for there are two cirriform postsetal lobes instead of the usual one. A somewhat similar arrangement is described by Willey (1905) for *Diopatra amboinensis* from Ceylon. The ventral cirrus which is cirriform for the first 4 or 5 feet later becomes a ventrolateral glandular pad. The dorsal cirrus is always cirriform but diminishes in size on posterior segments and develops a dorsal branchial trunk on the 4th, 5th or 6th foot. The structure of the gills has been studied by several workers but it seems that the method of preservation has so much effect that only the most marked differences remain constant for a species. Thus the number of branchiferous segments (usually 40–50) may be greater in large specimens and smaller in juveniles. The largest gill is usually the 3rd–6th but in juveniles it may be the first. In well-preserved specimens the branchial trunk is itself spiral but this is not true of compressed specimens removed from a tube. In most species the filaments have a length equal to 3–4 times the thickness of the trunk but in one species the basal filaments are hardly longer than the thickness of the branchial trunk.

Setae

The pseudocompound setae of the first four feet provide characters of the greatest importance—they may be unidentate, bidentate or tridentate and the guards (or hoods) may be well or poorly developed. The winged capillaries of later feet seem to vary in breadth of wings but the degree of serration at the base of the wing seems to change along the length of the worm. No significant departure from the norm has been noted in the structure of the four tapered acicula which just project from the setigerous lobe. The shape of the bidentate acicular setae seems to be very constant but the number of teeth on the comb-setae and the angle at which they are set seems to be diagnostic within limits. Thus in *D. neapolitana* there are a few large teeth (4–10), in *D. cuprea* there are numerous (15–25) small teeth and in *D. musseraensis* the blade is rolled up like a paper trumpet and at certain angles appears to have a stout central tooth as figured by Augener (1918) and Tebble (1955).

TUBE

In most species the projecting end of the tube is beset by shell fragments or other foreign objects such as leaves set edgeways on. In some, however, the tube is composed of hardened mud or sand without shells and Hartman has described one species with a ringed tube.

As mentioned earlier many records have been referred to the species *Diopatra neopolitana* which was regarded by Fauvel as being widely distributed in warmer waters. Among others, most of my own records from South Africa are incorrect and it is convenient before describing new material to redescribe a specimen of *D. neapolitana* from Naples and discuss the tangled synonymy.

Diopatra neapolitana Delle Chiaje 1825
(Fig. 9 *a–g*)

Diopatra neapolitana. Claparède 1868, p. 122, pl. 6, figs. 4 *a–h*. Ehlers 1868, p. 285, pl. 12, figs. 6–20.

non Diopatra neapolitana Crossland 1903, *nec* Day 1934, *nec* Day 1957, *nec* Tebble 1955, *nec* Monro 1936, *nec* Fauvel 1932, *nec* Wasenberg-Lund 1949.

Material (from Naples) British Museum numbers 1898: 5: 6: 137–9; 1919.11.6.25/26; 1921.5.1. 1873/74; 1876:10:4:41; 1890.6.7.9.13 other samples in the British Museum labelled *D. neapolitana* from South Africa, West Africa, West Indies, various parts of the Indian Ocean and Australia were not this species.

Diagnosis: Pseudocompound setae with a very small secondary tooth and well-developed guards; comb-setae with 4–10 teeth; a dark spot in the middle of the back on branchiferous segments.

Description: The following description is based on three British Museum specimens 98.5.6.137/9 from Naples. The specimens are very large, measuring 24 cm. by 5 mm. with over 250 segments. The general colour is brown, darker anteriorly and on the inner sides of the ceratophores of the occipital antennae. There is a short, dark, transverse, mid-dorsal bar on the anterior margin of each of the first 10 branchiferous segments (see fig. 9*e*).

The frontal antennae are tapered and fairly long. The ceratophore of the median occipital antenna has 9–11 rings and is about a third the length of its ceratostyle which has 20–25 broken longitudinal rows of clear cells projecting into the cuticle. The tentacular cirrus is three-quarters the length of the median ceratophore.

The mandibles have calcareous bilobed cutting edges and well chitinized, straight, dark, tapered shafts. The maxillae are also well chitinized and dark. The supports are heart-shaped and the main fangs (Mx. I) are strong. The dental formula is Mx. I (left) = 1 + (right) 1; Mx. II = 8 + 8; Mx. III = 8 + 0; Mx. IV = 7 + 8; Mx. V = 1 + 1. In one large specimen Mx. V = 2 + 2.

The first few feet tend to be bent forward and downward, and the first three (fig. 9*a*) are of the usual form described earlier for the genus *Diopatra*. The first gill occurs on the 4th or 5th foot. The largest gill is on the 7th or 8th foot and it extends two-thirds of the way across the dorsum; it has about 10–12 whorls of branchial filaments. Individual filaments of the basal whorls have a length equal to 3 to 4 times the thickness of the branchial trunk. Succeeding gills decrease slowly in size to end about the 50th foot. The presetal lobe is well marked from the 5th to the 20th foot and in these well-preserved specimens there is an obvious ventral projection (see fig. 9*b*).

The first four feet have 2 superior capillary setae and a fan of 5–6 hooded pseudocompound setae. The latter (fig. 9*d*) usually possess a very small secondary tooth but this may be absent. Pseudocompound setae are absent from the 7th foot and are replaced by winged capillaries which later develop serrations on the base of the wings. Comb-setae (fig. 9*g*) appear on the 8th foot and, tested over the whole length of the body, always have truncate ends with 5–10 coarse teeth. Two bidentate acicular setae (fig. 9*f*) appear on the 15th foot and persist over the rest of the body.

Discussion: Neither of the two descriptions given by Delle Chiaje (1825) and (1841) are sufficient for more than generic diagnosis, though the notes on pigmentation vaguely suggest *D. neapolitana*. Quatrefages (1865) described *D. gallica* which according to most authorities is synonymous with *D. neapolitana*, but not having seen the type, I must rely only on the published description which is not sufficiently detailed for *D. neapolitana*. On the other hand both the description of Claparède (1868) and Ehlers (1868) are very good. Claparède's figure 4*D* of the pseudocompound setae probably represents a broken seta but 4*E* shows an unidentate seta and the text states of the pseudocompound seta: '*son extremité se recourbe de manière à constituer une véritable serpe* (4*E*). *Chez quelques individus cette serpe est bidentée*.' If he had added that the secondary tooth is usually rudimentary the matter would have been clearer. His figures 4*H* and 4*J* show comb-setae with 7 and 10 teeth.

Ehlers (1868) gives a detailed description of pigmentation and of the mid-dorsal spot on branchiferous segments. His figures show comb-setae with 8 teeth but the pseudocompound setae were presumably broken off short as often occurs for he took them to be acicula and does not describe pseudocompound setae at all. Crossland (1903) who describes a different pigmentation, strongly bidentate pseudocompound setae and comb-setae with numerous teeth obviously had a different species in front of him. Fauvel (1923), whose figure 166*d* shows a comb-setae with few teeth and figure 166*f* shows a strongly bidentate pseudocompound seta presumably had more than one species before him. Fauvel (1930) and (1932) had specimens with numerous teeth to the comb-setae but the structure of the pseudocompound setae is not stated. Subsequent authors such as myself Day (1934) and (1957), Monro (1937), (1938), Tebble (1955) and Wesenberg-Lund (1949) have followed Crossland and Fauvel.

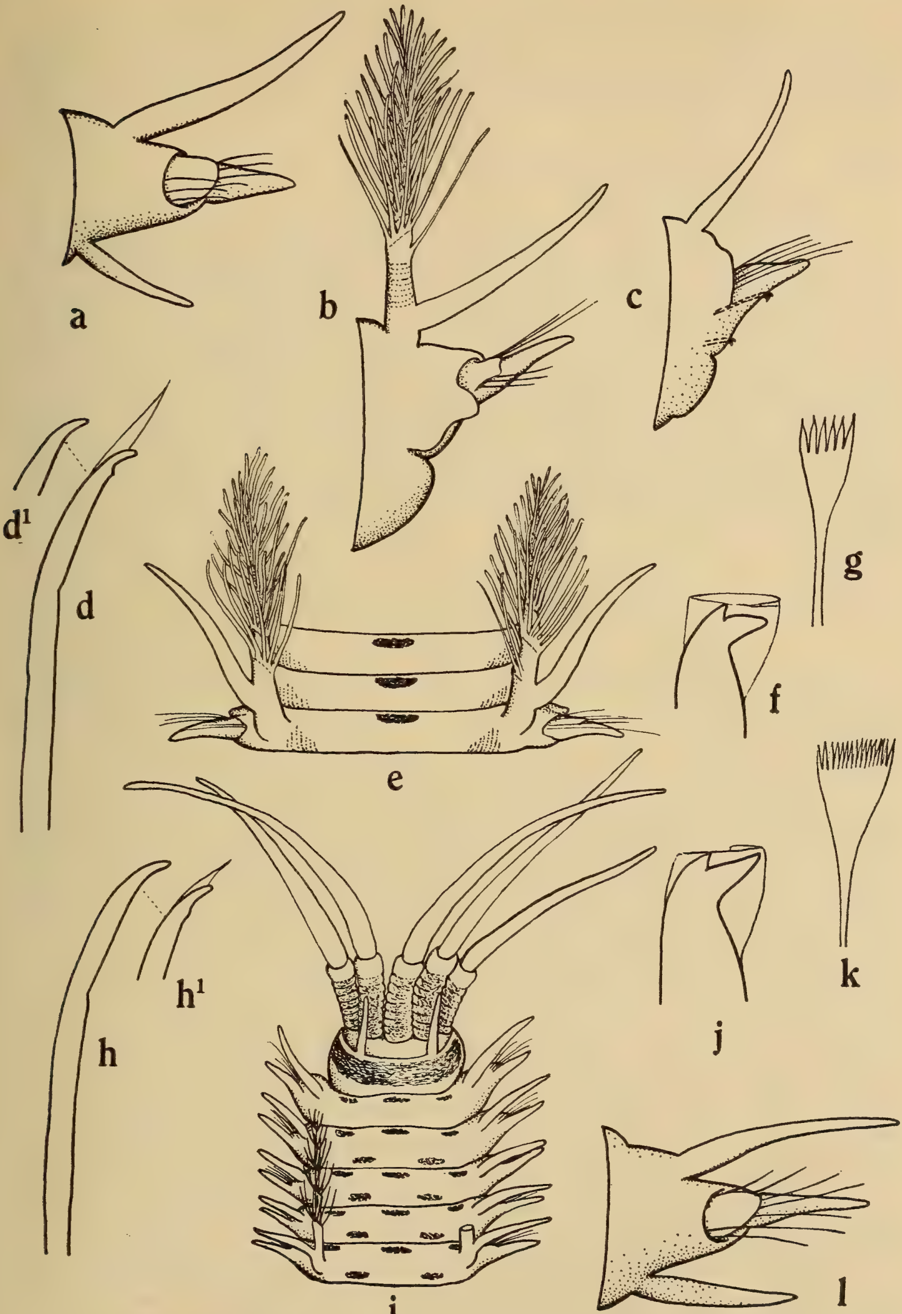

FIG. 9. *Diopatra neapolitana: a* anterior view of 2nd foot; *b* anterior view of 12th foot; *c* anterior view of posterior foot; *d*, d^1 pseudocompound seta of 2nd foot and an unidentate variety; *e* 10th segment showing pigmentation; *f* bidentate acicular seta; *g* comb-seta.

Diopatra neapolitana var. capensis: h, h^1 pseudo-compound seta and variation; *i* anterior end showing pigmentation; *j* bidentate acicular seta; *k* comb-seta; *l* anterior view of 2nd foot.

It would appear then that the true *D. neapolitana* which occurs at Naples and presumably elsewhere in the Mediterranean has often been recorded in error from the Indian Ocean, Australia, South Africa, tropical West Africa and the West Indies.

Note on specimens from Durban Bay

Record: DBN.26(6).

After the diagnostic characters of the genus *Diopatra* had been determined, all earlier collections from South Africa were re-examined, and among others the material from Morrumbene Estuary, Inhaca Island and Durban Bay reported by me (Day 1957) as *D. neapolitana*. The Morrumbene and Inhaca specimens proved to be *D. cuprea* but the Durban Bay specimens were *D. neopolitana*. The latter had the characteristic pigmentation, comb-setae with 5–9 teeth, the inferior projection from the presetal lobe of the 6th–12th foot but the pseudocompound setae were more variable than usual. Some were unidentate, some minutely bidentate and some had a well-developed secondary tooth.

Diopatra neapolitana var. *capensis* nov.

(Fig. 9 *h–l*)

Records: LAM.17(1), 48(4), 55(1), 56(5), 60(3), 63(1); SB.135(1), 181(1), 202(2); AFR.1535(1), 1544(1), 1581(p); TRA.91(1); FAL.209(1); MB.33(2), 34(1), 37(2), 81(4); LIZ.19(p), 23(3), 24(4); SCD.20(4), 63(10).

Description: The type is one of the 3 specimens from station LIZ.23 dredged in Algoa Bay at 33°58′S/25°43′E in 38·5 metres on a mud and clay bottom. It is an anterior half of a worm and measures 50 mm. by 4 mm. for 50 segments. The tube is of the usual form with broken shells attached edgeways. The differences between this variety and the stem form concern the colour pattern, the setae, the shape of the gills and the presetal lobe of branchiferous feet.

The central area of the prostomium between the occipital antennae is touched with brown and both the inner and outer faces (but not the sides) of the ceratophores are brown. The peristome (fig. 9*i*) has a continuous transverse bar and the first five setigers have 5 dorsal marks, 3 on the anterior margin and 2 posteriorly thus ¯_¯_¯. Within the next few segments the 3 anterior marks fade but the 2 posterior marks persist to the middle of the branchiferous region.

The cuticle of the occipital antennae has 25 rather irregular rows of clear oval cells projecting into it.

The only obvious difference in the shape of the feet between the Cape and the stem form from Naples, concerns the presetal lobe which, in the stem form, is well developed between the 6th and 15th feet. In this Cape material the inferior projection of the presetal lobe is poorly marked or absent so that the lobe is symmetrical.

The gills appear on the 4th or 5th foot, soon reach a maximum size and thereafter decrease gradually to end about the 50th foot. Each gill has a characteristically long stout trunk and short filaments; thus the basal filaments first appear half-way up the trunk and are not longer than twice the width of the trunk.

The pseudocompound setae of the first feet (fig. 9*h*) are almost always unidentate and only on one specimen was a small rudiment of a secondary tooth found. Moreover this Cape material usually lacks hoods over the apices of the pseudocompound setae and only in a few cases have vestiges of hoods been seen. Comb-setae (fig. 9*k*) with 9–12 rather fine teeth appear about the 12th foot, and bidentate acicular setae (fig. 9*i*) on the 18th foot.

Juvenile and Epidiopatra stages. Five young stages were found which varied from 15 mm. to 25 mm. in length. Three of them lacked tentacular cirri but the cirrophores of the occipital antennae were quite normal, 7-ringed and without lateral branches such as commonly occur in *Epidiopatra* species. Pseudocompound setae were unidentate and provided with small hoods. No comb-setae had been developed but bidentate acicular setae were found in posterior feet. Gills were present from the 4th or 5th foot to the 9th, 10th or 11th. The first gill was not only larger than succeeding ones but also better developed. The only markings were brown spots in the intersegmental junctions above the feet in the middle of the body (cf. *D. punctifera* Ehlers).

Two other specimens of the same size possessed tentacular cirri and had better-developed gills from the 4th to the 16th foot. In all other respects they agreed with the Epidiopatra stages.

This evidence, together with that of Monro 1924A who described a juvenile *Diopatra cuprea* from Madeira which also lacked tentacular cirri and the note below (p. 350) which describes the Epidiopatra stages of *Diopatra dubia*, shows that the juveniles of certain species of *Diopatra* lack tentacular cirri. However, this is not always the case. Among empty *Diopatra* tubes dredged from False Bay was a mud cocoon containing 6 post-larval *Diopatras* of 8–15 mm. Each had a normal pair of tentacular cirri, obvious spiral gills and bidentate pseudocompound setae.

Diopatra monroi n. sp.
(Fig. 10 *a–f*)

Diopatra cuprea (non Bosc) Augener 1918, p. 530, text-fig. 39 (partim).
Diopatra punctifera (non Ehlers) Monro 1930, p. 124, fig. 44 *a–b*; 1936, p. 147.

Records: SB.124(1), 208(1); LB.162(3); WCD.26(1); AFR.718(7); TRA.68(abundant), 70(c), 77(c), 88(8), 89(fc); FAL.352(2).

Diagnosis: Pseudocompound setae strongly bidentate; mandibles stout and thicker in the middle than at the ends; tube usually of compacted mud.

Description: The holotype is one of 7 anterior fragments from AFR.718.D. It is 28 mm. long by 4 mm. wide with 66 segments. The complete worm was

probably twice this length and not fully grown. The general colour is brownish anteriorly and pale posteriorly, but the important features are that there is a dark spot on the prostomium behind the median occipital antenna and the peristome and anterior segments have brown cross bars across the back which are best marked in the branchial region (see fig. 10*c*).

The frontal antennae are ovoid and the five occipital antennae are borne on ceratophores with 6–8 rings. The median antenna is 4–8 times the length of its ceratophore. When the cuticle is skinned off the antenna no clearly marked rows of cells were found projecting into it. If such cells are present they must be poorly developed. No eyes are visible on the prostomium.

The mandibles (fig. 10*b*) are quite characteristic. The cutting edges are normal and white but the supports are black, sausage- or spoon-shaped and curved. Even in juveniles where the mandibles are pale they are thicker in the middle than at the ends. The maxillae on the other hand are always weakly chitinized and brown. The supports are heart-shaped and the main fangs (Mx. I) are soft. The dental formula of the type is: Mx. I = 1 (left) + 1 (right); Mx. II = 5 + 7; Mx. III = 6 + 0; Mx. IV = 5 + 7; Mx. V = 1 + 1.

Dissection of other specimens shows that the number of teeth is not constant so that the average formula is: Mx. I = 1 (left) + 1 (right); Mx. II = (5–7) + (6–8); Mx. III = (6–8) + 0; Mx. IV = (5–10) + (7–10); Mx. V = 1 + 1. The fifth pair of plates are pale with a single dark tooth on the edge of each.

Anterior feet (fig. 10*a*) each have an ovoid and compressed setigerous lobe, tapered dorsal and ventral cirri and a tapered post-setal lobe. The presetal lobe is not developed in the first few feet. The dorsal cirrus persists throughout the branchiferous region but gradually becomes more slender and reduced in size. The ventral cirrus is reduced over the first 5 feet and from the 6th onwards, it is represented by a ventro-lateral glandular pad. The setigerous lobe soon becomes less obvious and on the 6th foot it is concealed behind a low, swollen presetal lobe. The postsetal lobe is gradually reduced in size to a conical papilla. Gills appear on the 5th foot, reach a maximum size by the 8th foot and continue to the 43rd foot. Gill filaments are of normal length and appear fairly near the base of the trunk which is not particularly stout.

The first four feet bear a fan of setae including 1–2 superior simple capillaries and 4–5 pseudocompound setae (fig. 10*e*) each with a strongly bidentate tip covered by a pointed hood. Only the simple capillaries persist and these become more numerous in posterior segments; the blades remain narrow and do not develop serrations at the base. From the 6th or 8th foot comb-setae with 15–25 teeth appear. Bidentate acicular setae with guards (fig. 10*f*) appear about the 16th foot.

The tube is of hardened mud or occasionally of sand and no sign of shells have been seen in many hundreds of specimens examined, even in those from shallow depths where the substratum is sand and shells. This species occurs on

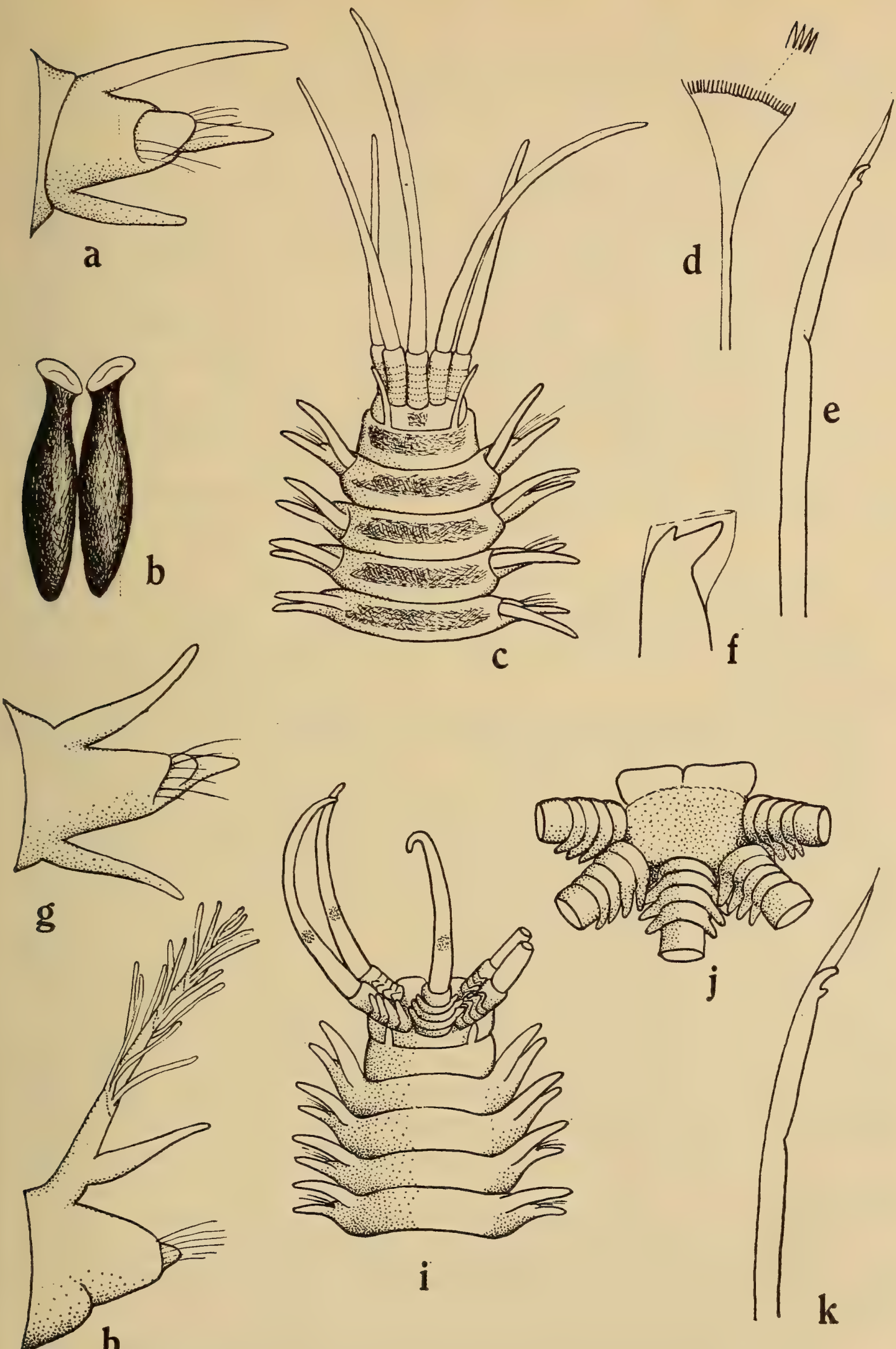

FIG. 10. *Diopatra monroi: a* anterior view of 2nd foot; *b* ventral view of mandibles; *c* anterior end; *d* comb-seta; *e* pseudocompound seta from 2nd foot; *f* bidentate acicular seta.

Diopatra dubia: g anterior view of 2nd foot; *h* anterior view of 8th foot; *i* anterior end; *j* anterior view of prostomium with ceratostyles omitted; *k* pseudocompound seta from 2nd foot.

muddy bottoms along the west coasts of South and South West Africa in enormous numbers. The main banks are 60–100 fathoms deep and fishermen report that at times the mud tubes may clog a trawl so that the gear has to be cut away.

I have examined the specimens recorded by Monro (1930) and (1936) as *D. punctifera* and find that they are identical with the specimens described here; equally certainly they are not the *Diopatra punctifera* which Ehlers described from the Agulhas Bank. Monro himself drew attention to the difference in the mandibles which are so characteristic.

By the courtesy of the Director of the Hamburg Museum I was able to examine the three specimens V.8718 recorded by Augener 1918 from Swakopmund under the name of *D. cuprea*. According to Augener they were obtained from mud tubes, and they still retain a dark spot behind the ceratophore of the median antenna and brown cross-bars across anterior segments. The mandibles have stout black spoon-shaped shafts. They are in fact typical examples of *D. monroi*.

Diopatra dubia n. sp.

(Fig. 10 *g–k*)

Records: TRA.73(2), 80(2), 110(1), 113(1), 143(3); FAL.237(3), 240(3), 352(3), 376(3).

Diagnosis: A small species with poorly developed gills, flattened, shovel-like frontal antennae and side branches on the ceratophores of the occipital antennae.

Description: The holotype was selected from a collection of 7 specimens from FAL.237.H. It is a well-preserved specimen measuring 23 mm. by 1·8 mm. with 50 segments. The tail end is missing. The tube is rather fragile and composed of flocculent debris, small sand grains and calcareous fragments. The worm is mainly pale but there are golden brown markings anteriorly though in other specimens these may be faint or lacking. The type has flecks forming a rough circle on the slightly concave area of the prostomium between the antennae and 3 paratypes each have a brown spot in the ceratostyle of the occipital antennae. The anterior segments are ringed with brown with a break over the ventral nerve cord and the glandular ventral cirri. The markings are strongest between the parapodia and persist there after they have faded elsewhere. The palps are oval cushions projecting outwards below the frontal antennae.

The frontal antennae (fig. 10*j*) are unusual. Instead of being stout and cylindrical as in most species, they are flattened, much broader than long and rather spade-shaped. In large specimens they are fused for most of their length.

The occipital antennae (fig. 10*i*) all have 5-ringed ceratophores with side projections on each ring except the enlarged terminal one. The median antenna has branches on either side of its ceratophore but the inner laterals and outer

laterals only have branches on their medial sides. The ceratostyles are relatively short, and the whole median occipital antennae only reaches back to setiger 3.

In fresh specimens an internal brown spot may be seen in the ceratostyle. The jaws are very weakly chitinized. The mandibles have calcified cutting edges but their straight, tapered shafts are pale except for narrow black lines on the inner edge of the dorsal surface. The maxillae are equally soft and only the teeth, outer margins and a conspicuous crescentric area medial of Mx. IV is blackened. The supports as usual are heart-shaped and starting with the main fangs (Mx. I) the formula of the holotype may be expressed as: Mx. I = (left) 1 + (right) 1; Mx. II = 9 + 9; Mx. III = 9 + 0; Mx. IV = 6 + 9; Mx. V = 1 + 1. Dissection of other specimens has shown that this formula is higher than most and the range is shown by the figures in brackets: I = 1 (left) + 1 (right); II = (5–9) + (6–9); III = (6–9) + 0; IV = (5–6) + 9; V = 1 + 1.

The peristomium bears a pair of rather short but quite obvious tentacular cirri showing clearly that the type material must be included in the genus *Diopatra* as at present defined.

The anterior feet (fig. 10*g*) are of the usual form. There is an ovoid setigerous lobe with a rather short cirriform post-setal lobe behind it. The cirriform dorsal cirrus above is considerably longer and the cirriform ventral cirrus below is almost as long.

The dorsal cirrus develops a dorsal gill on the 5th foot. However, the gills (fig. 10*h*) are never well developed. The largest gill is the 3rd on the 7th foot and this has only 2–3 whorls of filaments and just reaches across the mid-dorsal line. Thereafter the gills diminish rapidly and in most cases there is only a small dorsolateral tuft of filaments. The last gill occurs on the 30th foot. The postsetal lobe of anterior feet diminishes in size posteriorly, fuses with the setigerous lobe and disappears about the 25th foot. The cirriform ventral cirrus of the first 3–4 feet becomes a ventrolateral pad on later segments. No presetal lobe was distinguished.

Apart from the 4 colourless and tapered acicula present in all feet, the anterior feet each have one superior capillary seta and about 5 pseudocompound setae (fig. 10*k*) with long pointed hoods over the usual strongly bidentate tips. The pseudocompound setae are replaced by winged capillaries on the 6th foot. These increase to 12 and then decrease again to about 4. Bidentate acicular setae with guards appear about the 10th foot and fine comb-setae with 18–20 teeth appear on the 15th.

One specimen (not the holotype) has a complete posterior end which bears two fine cirri below the anus.

The above description of a small species of *Diopatra* with shovel-shaped frontal antennae, branched ceratophores to the occipital antennae and poorly developed gills would seem at first to be an unusually well-defined species of *Diopatra*. However, further samples revealed very similar worms of the same size which *lacked tentacular cirri*. Careful study revealed certain small differences

detailed below but it was obvious that all these forms were very closely related if not mere sexual differences or growth forms of the same species. The question immediately arose as to whether the genera *Diopatra* and *Epidiopatra* are distinct. All the present material was re-examined as well as specimens of *Epidiopatra hupferiana* and *E. drewinensis* from tropical West Africa and Monro's material from False Bay which has been referred by me (Day 1957) to *E. hupferiana* var. *monroi*. It should also be noted that the discovery of a cocoon of *Diopatra neapolitana* var. *capensis* containing newly hatched juveniles 10–20 mm. in length with well-developed tentacular cirri shows that in one species of *Diopatra* at least, these structures are present from the earliest stages. I have finally decided to leave the matter open for the present and merely give the characters of the form with tentacular cirri below.

Notes on an 'Epidiopatra form' of Diopatra dubia

Records: TRA.73(3), 74(1), 80(2).

Notes: This is a form of *Diopatra dubia* which agrees with the above description with the following exceptions.

Tentacular cirri are absent. Occipital antennae have ceratostyles which are 2–3 times the length of their ceratostyles. The hoods of the pseudocompound setae are considerably longer and the gills are even more poorly developed.

These 'Epidiopatra forms' differ from *Epidiopatra hupferiana* var. *monroi* in pseudocompound setae, in tube formation, in pigmentation, in number of gills and in the shape of the frontal antennae which are broad and flat instead of elongate and cylindrical. Again the ceratophores of the occipital antennae are much more richly branched. The gills are very similar to *E. hupferiana* from tropical West Africa but the other characters are still distinctive and the tubes are not plastered with shell fragments.

Diopatra cuprea (Bosc) 1802

Diopatra cuprea. Augener 1918, p. 350, text-fig. 39 (*partim*). Hartman 1944, p. 54, p. 1, figs. 9–14.
Diopatra neapolitana (non Delle Chiaje) Crossland 1903, p. 132, pl. 14, fig. 1. Day 1934, p. 54. Day 1957, p. 92 (*partim*).

Notes: I have re-examined my own specimens from Portuguese East Africa and have compared them with specimens in the British Museum from the Gold Coast. They all agree with Hartman's description of *D. cuprea* collected on the Atlantic coast of the U.S.A. near Bosc's type locality (Charleston). The pigmentation is diffuse brown and no clear pattern could be distinguished, except that there is a dark internal spot at the base of the dorsal cirri of the first two feet. Tentacular cirri are rather longer than usual, almost as long as the ceratophores of the long occipital antennae. When the cuticle was removed from an occipital antenna, 15–20 broken longitudinal rows of clear cells are seen projecting into it. Pseudocompound setae are strongly bidentate and have well-developed hoods. Comb-setae have 18–25 teeth. The presetal lobe of the 5th–15th foot is small and symmetrical.

It is very probable that many of the records of *D. neapolitana* from the Indian Ocean which refer to specimens with bidentate pseudocompound setae and comb-setae with numerous teeth really refer to *D. cuprea.*

Diopatra cuprea var. *punctifera* Ehlers 1908

Diopatra punctifera Ehlers 1908*a*, p. 78, pl. 10, figs. 1–11.

Records: TRA.143(2); False Bay: 25 records from 7–64 metres on shelly sand; MB.81(3); KNY.6(1); LIZ.3(c); SCD.1(2), 25(c), 26(6), 33(1), 50(c), 58(1), 61(c), 63(3), 74(1), 78(2), 80(1), 94(2).

Description: This Cape material differs from tropical specimens of *D. cuprea* in several minor respects but these differences are constant and for this reason it is as well to refer them to a separate variety for the present. The differences concern the pigment pattern, the cuticle of the occipital antennae and the comb-setae.

The colour pattern though often faint shows a transverse row of 4 brown spots across the back of each of the first 4–8 segments near the posterior margin thus - - - -. In the anterior branchiferous region the two inner spots on either side of the mid-dorsal line spread and fuse with the outer spots so that the whole back is brown with a white streak down the middle. When the clear cuticle is removed from one of the occipital antennae, scattered clear cells are found. The comb-setae have rather fewer teeth than in the stem form. In three specimens comb-setae appeared on the 6th, 8th and 9th foot and in different parapodia the number of teeth on the comb-setae was 9, 14, 13, 14, 9, 10, 15, 14, 11, 15, 18 giving a range from 9–18.

The feet are of the usual form without any distinctive features. In the first five the setigerous lobe is oblique and in setigers 8–15 the presetal lobe is symmetrical without any inferior projection.

Ehlers (1908*a*, p. 78) has included *D. neapolitana* as a synonym of *D. cuprea* and records specimens from 16°36′S/11°46′E (off South West Africa), 33°50′S/25°48′E (Port Elizabeth). He states that the colour pattern is variable and his synonymy suggests that he had more than one species in his collections.

Diopatra punctifera Ehlers (1908*a*) recorded from the Agulhas Bank at 35°19′S/20°15′E is not clearly described. Setae of the first 4 feet are stated to be '*hellgelebraun, zusammengesetzt: der dunne Schaft läuft mit einem wenig hakenformig gekrümmten,* 0·06 *mm. langen Endglied aus, das mit einfachen gedeckten Zahn endet, die Deckplatte ist über den Endzahn hinaus verlängert; vereinzelt stehen daneben feine einfache Capillarborsten* (*Taf. X, fig.* 7)'. Reference to fig. 7 shows neither a simple capillary nor a unidentate pseudocompound seta but a strongly bidentate seta. The comb-seta is shown with numerous teeth.

Dr. Hartwich of the Berlin Museum very kindly sent me the type material of *D. punctifera* for further examination. There are two specimens, both with mud tubes without any shell fragments. The colour is faint and although the

anterior branchiferous region is brownish, no colour pattern remains nor are there any 'eye spots' between the parapodia to which Ehlers refers.

The median ceratophore has 8 rings and the median occpital antenna is a little shorter than the inner laterals with a cuticle which shows a few scattered cells. The tentacular cirri are longer than usual, almost as long as the ceratophores. The mandibles have straight tapered shafts and both the mandibles and the maxillae are weakly chitinized. The maxillary formula is given by Ehlers.

Anterior parapodia are of the usual shape without any peculiarities; there is no presetal lobe other than a swelling from the 6th setiger onward. The gills start on the 5th foot, have fairly slender trunks and filaments whose length is 4–5 times the diameter of the branchial trunk.

The first few feet have 1–2 capillaries and about 4 pseudocompound setae with well-developed hoods and bidentate tips; the secondary tooth is well developed but distinctly smaller and more slender than the terminal one. Bidentate acicular setae of the usual shape first appear on the 15th foot and comb-setae are present on the same foot. The comb-setae are fairly long and have 15–18 fine teeth set on the very slightly oblique blade.

Ehlers's type and my specimens from the same locality agree very well though the colour pattern of the type has faded and the comb-setae have rather more teeth than usual.

Epidiopatra gilchristi n. sp.

(Fig. 11 *a–f*)

Records: SCD.33(1), 100(10), 103(2).

Diagnosis: A long slender species with a tough, translucent tube which is sometimes annulated (fig. 11*a*).

Description: The holotype is an incomplete specimen from SCD.33 partly removed from its annulated tube. It is 55 mm. long by 0·5 mm. wide with more than 150 segments. There appear to be large eggs at the posterior end but the tube is so tough that it is impossible to remove them without damage. The body is creamy brown in alcohol with faint brown spots in the occipital antennae.

The head (fig. 11*d*) bears a pair of subspherical palps, stout subulate frontal antennae and five occipital antennae born on 5 ringed ceratophores. The inner laterals have one or two blunt projections on the basal rings of the ceratophores. The ceratostyles of the median and inner lateral antennae are three times as long as their ceratophores and extend back to setiger 5 but those of the outer laterals are considerably shorter. The head is generally pale in alcohol but there are brown flecks on the prostomium between the antennae and a row of ocular specks may be discerned outside the bases of the inner lateral antennae. The peristome is longer and darker than the succeeding segments. There are no tentacular cirri.

The jaws are pale and very weakly chitinized. The mandibles have white cutting edges and their shafts are so pale that they are hardly distinguishable

from the muscle. They appear to be straight and tapered. The maxillae are mainly colourless but the teeth are tinged with brown and Mx. V are toothless crescents of a darker brown. The dental formula is: Mx. I = 1 (left) + 1 (right); Mx. II = 8 + 7; Mx. III = 7 + 0; Mx. IV = 6 + ?10; Mx. V = 0 + 0. The first three feet are ventro-lateral in origin and are directed forwards. All the lobes are flattened against the side of the body probably due to compression inside the tube. The first foot (fig. 11*e*) has a subulate dorsal cirrus, a low presetal fold, then the setae and then a conical postsetal lobe and an inferior rounded papilla. The ventral cirrus is short and blunt. The next two or three feet are generally similar but thereafter the ventral cirrus is reduced to a low glandular pad and the postsetal lobe decreases in size. The first gill (fig. 11*f*) appears on the fourth foot as an outgrowth from the small dorsal cirrus. It has a stout trunk bearing 6 finger-like filaments in an open spiral. Succeeding gills are smaller and the last arises from setiger 7 so that there are four pairs of gills in all. Specimens dredged off Natal (station NAD.10) also had four pairs but in this case they started on setiger 5. Specimens from SCD.100 and SCD.103 had only one gill on setiger 5.

The post-branchial feet each consist of a fingerlike dorsal cirrus, a rounded setigerous lobe with a sheaf of setae and minute post-setal papilla and below this a cushion-like ventral cirrus.

The setae of the first three feet consist of about 8 stout pseudocompound setae (fig. 11*b*) with strongly bidentate tips and well-marked hoods. The dorsal cirrus contains 3 fine acicula and the setigerous lobe has 3 stout ones whose pointed tips just pierce the surface. In the fourth or fifth foot broad-bladed capillaries appear and by the 6th foot the pseudo-compound setae have gone and the first comb-seta appears. It has about 12 teeth. Two bidentate acicular setae appear in the post-branchial feet.

This species is easily distinguished from *E. hupferiana v. monroi* by the character of its tube (fig. 11*a*).

Epidiopatra hupferiana Augener var. *monroi* Day 1957

Epidiopatra hupferiana Augener var. *monroi* Day 1957, p. 92.

Records: FAL.219(1), 245(1 juv.), 328(1), 365(1), 376(1), 378(2); MB. 88(1).

Notes: The tubes are fragile and covered with debris,—hydroid stems, pieces of alga, shell fragments, mud and flocculent matter. The worms are typical and most have only 3 pairs of gills but a large 60 mm. specimen had 4 pairs. In fresh specimens 4 broad brown streaks extend along the back but these tend to fade to a uniform brown on preservation in alcohol. I have examined Monro's specimen in the British Museum (registered number 1930:10:8:1372) and find it agrees with my type, but the colour has faded and the ceratophores of the occipital antennae lack lateral branches. The latter character is variable.

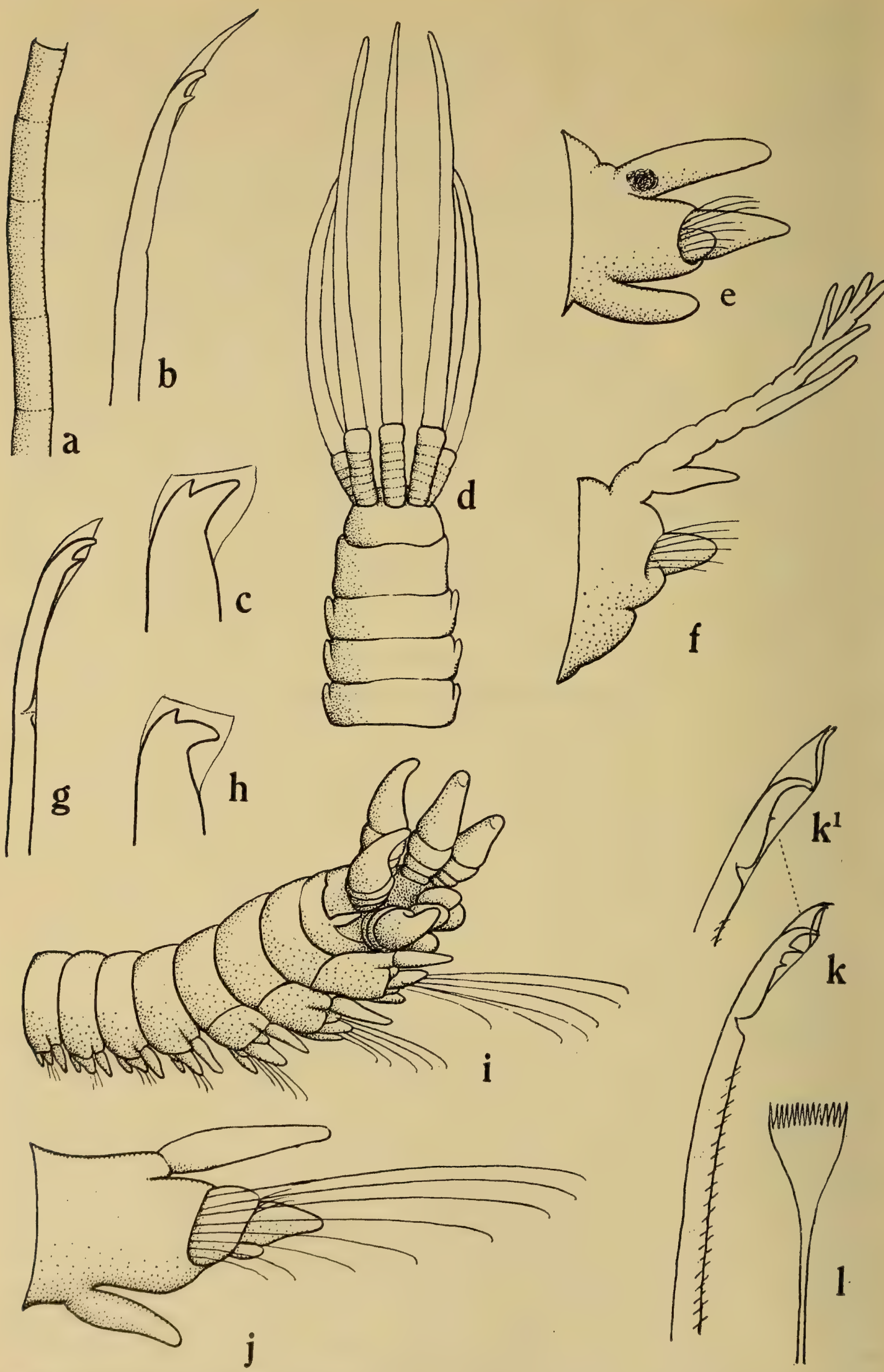

FIG. 11. *Epidiopatra gilchristi: a* Tube; *b* pseudocompound seta from the first foot; *c* bidentate acicular seta; *d* anterior end; *e* anterior view of first foot; *f* anterior view of 4th foot.

Leptoecia antarctica: g pseudocompound seta; *h* bidentate acicular seta.

Rhamphobrachium capense: i, anterior end; *j* anterior view of first foot; *k*, k^1 pseudocompound seta and unidentate variation (LIZ.25); *l* comb-seta.

A juvenile with 42 segments measuring 9 mm. (FAL.245.J) was obtained which probably belongs to this species. The frontal antennae are ovoid, the ceratophores of the occipital antennae have small lateral branches, tentacular cirri are absent and no gills have been developed. It is interesting to note that eye specks are still present behind the inner lateral antennae and the ventral cirri are cirriform on only the first 3 instead of the first 5 feet as in the adult.

Rhamphobrachium capense n. sp.

(Fig. 11 *i–l*)

Records: TRA.152(1); FB.307(c), 322(1); FAL.58(p), 117(1), 219(c), 378(1); MB.62(1); ?LIZ.25.T(1); SCD.89(2).

Diagnosis: Gills as single filaments from 30th–40th foot; anterior pseudocompound setae tri- or bidentate with clawed hoods.

Description: The holotype is a well-preserved specimen with 78 segments measuring 34 mm. The tail end is missing. It was selected from among 30 specimens dredged in False Bay. The tube is weakly constructed of mucus with adherent fragments of shells, coralline algae and a few sand grains. Fresh specimens show dark marks on the prostomium, palps, ceratophores of the antennae, parapodia and there are two rows of spots on the dorsum. All of these markings fade in alcohol and the type is colourless apart from tiny black eyespots at the base of the inner lateral antennae.

The prostomium (fig. 11*i*) is ovoid with cushion-like palps, ovoid frontal antennae and 5 short stout occipital antennae which just reach back to setiger 1. Each of these antennae consists of a stout bulbous ceratophore with 2 rings at the base and a slightly longer subulate ceratostyle. The peristomium is narrow and the tentacular cirri when laid forward do not reach the bases of the occipital antennae.

The first few segments are usually tilted upward so that the first two feet point forward, the 3rd–5th obliquely downward and the rest are normally lateral. Anterior feet (fig. 11*j*) have subulate dorsal and ventral cirri, a low presetal lip and two unequal conical postsetal lobes of which the superior is much the larger. The inferior postsetal lobe disappears after the first 3–4 feet. Then the superior postsetal lobe is reduced and on the 12th foot it is no more than a low rounded cone. The dorsal cirrus retains its structure throughout but becomes reduced in size. Between the 30th and 40th segment a single branchial filament grows out from the dorsal cirrus and soon greatly exceeds it in length and continues to near the end of the body. The short ventral cirrus is conical for the first 4 feet, reduced on the 5th and on subsequent segments it forms a ventral glandular pad.

The first three feet each have a few very small capillaries and 12–18 long pseudocompound setae (fig. 11*k*) projecting forward. The apex of each is bidentate or occasionally tridentate though the third tooth is minute and the

bivalve hood which covers the apex terminates in tiny claws. The shaft has two rows of spinules along the inferior margin. In the single specimen from Algoa Bay (LIZ.25.T) which is otherwise similar to the Cape material, the pseudo-compound setae were unidentate or minutely bidentate, the shafts had finer spinules and the ends of the hoods though bent, were not clawed.

The next few feet (e.g. the 8th) lose the pseudocompound setae and have about 8 winged capillaries while 2 acicula with long tapered tips project from the surface. In posterior feet either the capillaries are modified to develop long slender tips like the acicula, or the acicula themselves become more numerous and project further from the parapodium. Apart from these very tapered capillaries or acicula there are 2–3 fine comb-setae (fig. 11*l*) with about 12 teeth and 1–2 brown acicular setae with the usual bidentate apex and guards.

This species differs from those previously described by the position and nature of the gills and the structure of the pseudocompound setae.

Hyalinoecia tubicola (Müller) 1788

Hyalinoecia tubicola. Fauvel 1923, p. 421, fig. 166 *i–q*.

Records: AFR.831(1).

Leptoecia antarctica Monro 1930
(Fig. 11*g*, *h*)

Leptoecia antarctica Monro 1930, p. 133, fig. 50.

Records: FAL.131(2 juvs.), 159(2); ?SCD.3(8).

Notes: The False Bay material agrees well with Monro's specimens dredged off the South Shetland Islands in 1,080 metres. The present specimens are rather smaller, the only complete individual measuring 23 mm. by 0·8 mm. for 70 segments. Tubes are missing. The worms are uniformly pale in spirit, but small eyes are visible external to the bases of the inner lateral occipital antennae.

The frontal antennae are ovoid to sausage-shaped, the occipital antennae have ceratophores with 4 rings and the ceratostyles are at least 5 times the length of their ceratophores. The median antenna which is shorter than the inner laterals reaches back to setiger 8.

Tentacular cirri are absent and the peristome is about the same length as succeeding segments.

The first three feet project outwards and downwards, but succeeding ones change until over most of the body the parapodia are dorsolateral. Dorsal cirri are always cirriform. Anterior ones are approximately equal to the segmental length but over the rest of the body they are much shorter and roughly equal to the setae. The setigerous lobe of the foot is never prominent.

The postsetal lobe is cirriform for the first 3 feet, then decreases and is not distinguishable after the 8th foot. A presetal lobe is not developed. The ventral cirrus is cirriform on the first three feet and thereafter becomes a glandular pad which becomes continuous with the setigerous lobe from about the 10th foot.

The first 3–4 feet contain about 4–6 pseudocompound setae (fig. 11*g*) with bivalve hoods and bidentate apices, the second tooth being much smaller and more slender than the terminal one. Winged capillaries appear about the 4th foot and by the 8th foot there are 4 capillaries with blades well marked off from the shafts. Two bidentate acicular setae (fig. 11*h*) appear in the 9th foot and comb-setae with about 14 teeth further back. An average foot in the middle of the body has 4 winged capillaries, 1–2 fine comb-setae, 2 stout acicula with fine tapered and projecting tips, and 2 bidentate acicular setae with guards.

The posterior end of the body bears 2 pairs of anal cirri which are a little shorter than neighbouring segments.

The above description reveals several minior differences from Monro's types with which the present specimens have been compared. In particular, South African specimens have more elongate frontal antennae, they have eyes and the secondary tooth of the pseudocompound seta is distinctly smaller and smore slender than the terminal one.

The 8 specimens from station SCD.3 are doubtfully referred to *L. antarctica*. The material consists of a number of fine horny tubes up to 40 mm. in length and 0·5 mm. in diameter attached to a stone. The basal parts of the tubes have sand grains attached to them but the distal parts are naked and erect. Moreover several of them are twisted into a fine spiral. The worms inside are of course more slender than the False Bay specimens but seem to agree in structure.

Monro's specimens had mud tubes; the tubes of the False Bay specimens are unknown, and until more is known the identification of the SCD.3 material is doubtful.

Subfamily LUMBRINERINAE

Lumbrineris albidentata Ehlers 1908

(Fig. 12 *a–b*)

Lumbrinereis albidentata Ehlers 1908*a*, p. 97, pl. 13, figs. 7–13.

Records: AFR.736(p); TRA.41(7), 74(2), 80(6), 110(1), 113(c), 116(1), 143(c), TB.303(1), 309(1); FAL.95(1), 117(1), 206(1), 228(2), 238(2), 241(1), 243(1), 250(1), 251(10), 328(1 juv.), 345(1), 349(1), 375(1 juv.), 378(1); SCD.105(1).

Notes: Ehlers's type was small and incomplete and the present material which includes numerous specimens of all sizes, now makes it possible to supplement the original description. The prostomium is conical and there is a dorsal slit at its junction with the peristomium containing nuchal sense organs. The jaws are large and in juvenile specimens the first 3–4 segments are expanded

to accommodate them; in adult specimens this swelling is not noticeable. The mandibles are heavily calcified and the maxillae are quite characteristic, the formula being: Mx. I = 1 + 1; Mx. II = (2–3) + (2–3); Mx. III = 2 + 2; Mx. IV = 0 + 0; the teeth of Mx. II are often edged with white and in one juvenile (AFR.736.Q) gave the impression of having a double row of teeth. Mx. III are very small; Mx. IV are very large plates with a black margin in which a distinct tooth is not differentiated, but the whole forms a cutting edge, thus it is represented in the formula as 0 + 0. The maxillary supports are long and triangular without marked notches at their bases.

Anterior feet (fig. 12*a*) have lamellate lobes which are longer than deep. The presetal lobe is at first small, but in middle feet it is considerably larger, and in posterior feet (fig. 12*b*) it is almost as long as the postsetal lobe. Both lobes project outwards and upwards but are never as long as the setae, and much shorter than the posterior lobes of *L. bifilaris* or *L. meteorana*. Ehlers's type lacked posterior segments so he does not describe this bilabiate condition. There are long compound hooks from the first setiger changing to simple hooks at the 30th setiger and persisting to the end of the body. Winged capillaries are also present from the first foot but these decrease posteriorly so that at the 50th foot there is only one, but thereafter there are usually one or two in most posterior segments. The foot contains four yellow acicula.

Lumbrineris cf. *meteorana* Augener 1931

? *Lumbrinereis meteorana* Augener 1931, p. 300, fig. 8.

Records: SB.177(1), 199(1); WCD.23(1), 26(2).

Notes: Augener described an anterior and a posterior fragment as follows: Body very slender. Prostomium conical. Mandibles very pale with a tooth-shaped process near the symphysis. Maxillary formula: Mx. I = 1 + 1; II = 5 + 5; III = (1 or 2) + (1 or 2); IV = 1 + 1. Third maxillary plates with indistinct teeth—possibly 1 or possibly 2. Anterior feet with low presetal and postsetal lobes. Posterior feet with long threadlike presetal and postsetal lobes of equal length. Winged capillaries restricted to anterior feet. Hooded compound hooks in the first 20 feet but replaced by simple hooks over the rest of the body. Type locality: 17°13′S/11°43′E, off the coast of Angola.

My specimens agree perfectly with the above description except in regard to the maxillary formula. In my specimens the formula is 1 + 1; 3 + 3; ?2 + ?2; 1 + 1. Mx. II have three very stout almost bilobed teeth and Mx. III is a cutting plate which in some cases shows no teeth at all and in others shows two small projections. Mx. IV is a relatively large plate with a pale centre and a dark edge from which a single tooth projects. It may also be added that the prostomium is oval rather than conical, that the postsetal lobe of anterior feet is only slightly shorter than the postsetal one, that both lobes increase slowly in size over the middle of the body but in the last 20 segments or so both lobes increase enormously to form long threadlike projections. The acicula are pale

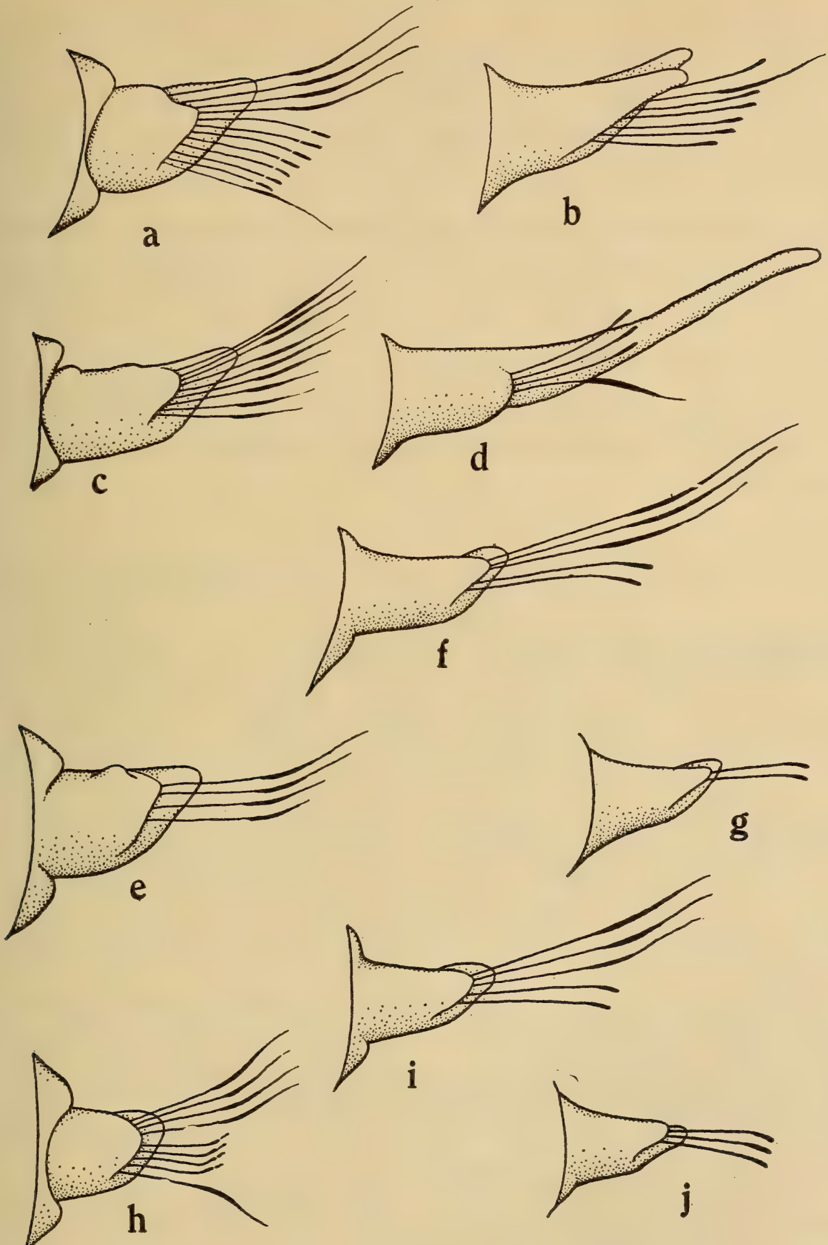

FIG. 12. *Lumbrineris albidentata: a* anterior view of anterior foot; *b* anterior view of posterior foot.

Lumbrineris heteropoda var. atlantica: c anterior view of 12th foot; *d* anterior view of posterior foot.

Lumbrineris brevicirra: e anterior view of anterior foot: *f* anterior view of middle foot; *g* anterior view of posterior foot.

Lumbrineris magalhaensis: h anterior view of anterior foot; *i* anterior view of middle foot; *j* anterior view of posterior foot.

and the hooks change from compound to simple at the 14th foot which is a little earlier than stated by Augener.

Since all the other characters agree so well, the difference in Mx. II is surprising. Augener's type should be re-examined and it may be that the anterior end he described does not belong to the posterior region with bilabiate feet.

My specimens differ from *L. bifilaris* Ehlers in the structure of the maxillae and in having jointed hooks anteriorly. In these characters it is closer to *L. albidentata* Ehlers described above but a side-by-side comparison proves that they are distinct. *L. albidentata* grows to be a much larger, stouter worm but even when compared with a juvenile it is evident that *L. meteorana* is longer and more slender, that Mx. III are larger plates with less distinct teeth, that the postsetal lobe of anterior feet is conical not lamellar and that both lobes of posterior feet are much longer and more threadlike than they are in *L. albidentata.*

Lumbrineris heteropoda Marenzeller var. *atlantica* nov.

(Fig. 12 *c–d*)

Lumbrinereis heteropoda Monro 1930, p. 137. Monro 1936, p. 154.

Records: LAM.44(1); SB.136(1), 179(1), 183(1), 202(4), 203(10); AFR. 882(1), 1224(1), 1535(1), 1545(1), 1554(1), 1576(1), 1335(1); TRA.68(c), 70(c), 71(fc), 77(c), 80(c); WCD.15(6), 19(3), 21(4), 23(9), 26(45), 28(6).

Notes: These are very large worms, a complete specimen being over 300 mm. long, 5 mm. wide and iridescent reddish brown in colour when alive.

The prostomium is short and conical and the maxillary formula as usual is Mx. I = 1 + 1; Mx. II = 4 + 5; Mx. III = 2 + 2; Mx. IV = 1 + 1, but the secondary tooth on Mx. III is poorly developed. The maxillary supports are heart-shaped and nearly as broad as long.

In anterior feet (fig. 12*c*) the presetal lobe is short and swollen while the postsetal lobe is ear-shaped and as deep as long. The feet soon increase in length and the postsetal lobe becomes relatively longer until at about the 60th foot it reaches the tips of the capillaries as a finger-shaped organ. In the posterior part of the body (fig. 12*d*) it is much longer than the setae and often three times as long as the basal part of the parapodium.

In anterior feet the setae are all winged capillaries with brown acicula embedded in the flesh. The superior group of capillaries have very long slender blades. Short-bladed simple hooks appear about the 40th foot and for the next 30 segments, both capillaries and hooks are numerous. Thereafter both types of setae become less numerous and in posterior feet there are about 4 hooks and one capillary. It is stressed that capillaries may be found even near the end of the body. The present material has been checked as identical with specimens described by Monro (1930) from Tristan da Cunha and, as has been

shown earlier (Day 1957, p. 94) there are small but constant differences from material recorded in the intertidal zone of the tropical Indian Ocean.

Lumbrineris cavifrons Grube 1869

Lumbrinereis cavifrons. Day 1953, p. 437, text-fig. 6 *a–d*.

Records: TRA.152(1); False Bay: 30 records from 0–35 metres on rock, gravel and shelly sand; MB.49(5), 57(1), 85(1), 87(4); LIZ.2(1), 18(3), 29(2), 35(2); SCD.40(1), 89(1).

Lumbrineris latreilli Aud. & M.-E. 1833

Lumbrinereis latreilli. Fauvel 1923, p. 431, fig. 171 *m–r*.

Records: FB.307(1), 319(1); FAL.334(1); TRA.132(5); SCD.50(1).

Lumbrineris tetraura (Schmarda) 1861

Lumbrinereis impatiens Claparède, Fauvel 1923, p. 429, fig. 171 *a–i*.
Lumbrinereis tetraura Day 1953, p. 435.

Records: LAM.22(1), 35(10), 38(1), 49(1), 52(1); SB.189(10); LB.300(c); SH.204(1), 415(1); TB.320(1); WCD.21(1); FB.331(1); FAL.58(p); LIZ.2(6), 27(1).

Lumbrineris coccinea (Renieri) 1804

Lumbrinereis coccinea. Fauvel 1923, p. 432, fig. 172 *g–n*. Day 1953, p. 436 with synonymy.

Records: TRA.122(1); WCD.8(1); FAL.8(p), 113(2), 126(3), 127(1), 144(1), 156(7), 162(3), 171(4), 182(1), 214(2), 269(2), 275(4), 327(1), 371(1).

Lumbrineris hartmani Day 1953

Lumbrinereis hartmani Day 1953, p. 437, fig. 6 *e–m*.

Records: FAL.245(1); MB.23(1), 88(1); LIZ.19(7), 25(3); SCD.58(4), 89(1).

Notes: Some of these specimens are much smaller than the holotype and the simple hooks appear as early as the 23rd segment as against the 45th in the type.

Lumbrineris brevicirra (Schmarda) 1861

(Fig. 12 *e–g*)

Notocirrus brevicirrus Schmarda 1861, p. 117.
Lumbriconereis brevicirra Ehlers 1904, p. 35, pl. 4, figs. 13–20; pl. 5, figs. 1–2.

Records: TRA.73(1); FAL.359(1).

Notes: The present specimens lack a posterior end. The prostomium is short and conical with a nuchal pocket at the junction with the peristome. The

maxillary formula is 1 + 1; 5 + 5; ?2 + ?2; 1 + 1. Mx. III are cutting plates with 1–2 indistinct teeth. The maxillary supports are heart-shaped.

Anterior parapodia (fig. 12*e*) are small and each has a poorly developed presetal lobe and a well-developed postsetal lobe which is compressed, deeper than long and roughly triangular with a superior point, rather like a dog's ear. Towards the middle of the body (fig. 12*f*) the whole foot grows longer, the presetal lobe becomes obvious and the post-setal lobe is reduced; further back still it is similar to, and not much longer than the small pointed presetal lobe (fig. 12*g*). The tail end of the worm is missing.

The anterior setae include both simple hooks and winged capillaries. The capillaries which have very long slender blades, start on the first foot and continue to the middle of the body (about segment 50). The simple hooks appear about the 12th foot and continue to the posterior end (segment 120). The blade is at first very long so that the anterior hooks give the impression of being capillaries with broken tips, but further back the blade decreases in length until it is only 2–3 times as long as broad. The acicula are pale throughout.

This South African specimen has been compared with a New Zealand specimen in the British Museum (No. 1928.2.29.156) identified by Benham (1927). Unfortunately the anterior setae are broken. Ehlers (1904, p. 36) states that Mx. II have 5 teeth on the left and 7 on the right, an unusually high number. However, his figure (p. 5, fig. 1) suggests that the number is smaller as do Schmarda's original drawings.

Lumbrineris magalhaensis Kinberg 1864

(Fig. 12 *h–j*)

Lumbrinereis pettigrewi McIntosh 1885, p. 239, pl. 36 figs. 7–9; pl. 17A, figs. 11–15, text-figs. 4–6.
Lumbrinereis magalhaensis. Ehlers 1897, p. 74. Monro 1930, p. 135. Hartman 1948, p. 93, pl. 14, figs. 1–3.

Records: FAL.352(1). McIntosh's record of *L. pettigrewi* is station 141 dredged in 98 fathoms off the Cape at 34°41′S/18°36′E.

Notes: McIntosh's type of *L. pettigrewi* is in the British Museum. An examination showed that the prostomium is long and conical; the dental formula is 1 + 1; 4 + 4; 1 + 1; 1 + 1. The maxillary supports are short and broad with practically no notch at the base, Mx. III are curved cutting plates without a distinct tooth, and are best represented in the formula as 1 + 1. The presetal lip of anterior feet (fig. 12*h*) is a low ridge. The postsetal lobe of anterior feet is flattened, has a rounded edge and is deeper than long, but further back (fig. 12*i*) it becomes more regularly digitiform. Even in the posterior part of the body (fig. 12*j*) it is much shorter than the setae. The presetal lobe increases in size but remains a little shorter than the postsetal lobe throughout. The majority of the setae are broken, but one or two com-

pound hooks remain in the 12th foot of one specimen and a few simple hooks without swollen ends were found in the posterior feet of another specimen. The acicula are yellow. According to McIntosh the capillaries which are very long and slender are restricted to the anterior part of the body. However, his account is very confused for he figures simple hooks in anterior foot of 'a variety', black acicula in one specimen and pale ones in another. Monro 1930 recorded *L. magalhaensis* from South Georgia and his specimens which were examined in the British Museum were found to be practically identical with McIntosh's *L. pettigrewi*. However, the following minor differences were noted. The prostomium is conical but short, the dental formula is the same, but the maxillary supports are slightly longer being 1·5 times as long as broad. In these complete specimens it may be seen that compound hooks are present from the first setiger. The postsetal lobe of anterior feet is again very deep but here not deeper than long. Specimen FAL.352 is an anterior half of a worm which has been compared with the type of *L. pettigrewi* and appears to be identical. In this fresh specimen the setae are unbroken and it can be seen that the compound hooks start in the first foot and persist to the 19th where they are replaced by simple hooks. All hooks have short blades. The parapodial lobes are short throughout and in posterior segments the presetal lobe is only slightly shorter than the postsetal one.

Ehlers (1897) described two forms of prostomium, one long and one short but both conical. This type of variation, probably due to the method of preservation, is quite common in the genus. Ehlers however has made one error in his description. He states that Mx. IV has two teeth. Both McIntosh's specimen of *L. pettigrewi* from the Cape and Monro's specimen of *L. magalhaensis* from South Georgia have Mx. IV in the form of a cutting plate with an undulating edge, but not two distinct teeth.

Hartman (1948) has redescribed Kinberg's type material of *L. magalhaensis* which consists of several specimens. One was without jaws and obviously dissected by Kinberg. In other characters however, this specimen agrees with the description given above, and Kinberg stated that *L. magalhaensis* has Mx. III with one tooth, and this is the interpretation accepted by Ehlers and Monro. Hartman dissected other specimens of the type material and found that in these Mx. III has 2 teeth and the maxillary supports are twice as long as broad. I suggest that these specimens are different from the one dissected and described by Kinberg and seem closer to *L. latreilli*.

Arabella iricolor var. *caerulea* (Schmarda) 1861

Arabella iricolor var. *caerulea*. McIntosh 1904, p. 46, pl. 4, figs. 16–17. Day 1953, p. 439, fig. 6*n*.

Records: TB.305(1), 319(3); FAL.44(1), 51(1), 58(1), 69(1), 80(1), 235(1), 245(1), 249(2); MB.23(1), 41(1), 42(1), 49(2), 56(5), 67(1), 85(1); LIZ.29(1); SCD.40(2), 89(6).

Arabella mutans (Chamberlin) 1919

Arabella mutans. Monro 1933, p. 501.

Records: FAL.184(1), 229(p).

Notes: These worms have slender bodies with the segments as long as broad. The prostomium is large and oval with four eyes in a line just in front of the prostomium/peristomium junction. The mandibles are strong and black; the maxillae have long filiform supports and a dagger-like median appendage. The first pair of maxillae do not form strong hooks, but all maxillary plates have the anterior tooth stronger than the succeeding ones, the formula being: Mx. $I = 8 + 8$; Mx. $II = 7 + 7$; Mx. $III = 6 + 6$; Mx. $IV = 4 + 4$; Mx. $V = 1 + 1$.

Parapodia have a pimple-like dorsal cirrus and no ventral cirrus. The foot has a low rounded presetal lobe and a fingerlike postsetal lobe. Between these are 3–4 winged capillaries with serrations at the base of the blade and two acicula with projecting filiform tips.

Drilonereis falcata Moore 1911

(Fig. 13 *a–e*)

Drilonereis falcata Moore 1911, p. 298, pl. 20, figs. 150–154. Hartman 1944, p. 179.
Drilonereis filum (non Clap.) Monro 1936, p. 158.

Records: FAL.219(1), 352(1).

Notes: A single anterior fragment of 66 segments was obtained. The prostomium (fig. 13*a*) is depressed, oval in plan and lacks external eyes though there is a faint suggestion that internal eyes may be present. The mandibles (fig. 13*c*) are stout, black and roughly triangular with a short hinge line. The maxillae (fig. 13*b*) have long filiform supports which are very narrow where they join the main fangs (Mx. I) and a dagger-shaped median piece which is blackened throughout. Mx. I are stout hooks with toothed bases, Mx. II are rectangular with the first tooth rather larger than the rest, Mx. III have an anterior large fang-like tooth and small denticles behind, Mx. IV and V which are very close together, each consist of a single fang. In the following dental formula the difference in size of teeth is not indicated as is sometimes done. Mx. $I = 8 + 6$; $II = 8 + 8$; $III = 4 + 3$; $IV = 1 + 1$; $V = 1 + 1$.

The first of the two achaetous segments is largely fused with the prostomium but leaves a crescentric depression on the dorsal surface. Anterior feet (fig. 13*d*) are small and may be partially retracted but succeeding ones rapidly increase in size. There is no dorsal cirrus. The presetal lobe of the foot is a low semicircular ridge at the base of the bluntly conical postsetal lobe. From the groove between the lobes project a fan of about 6 winged capillaries and the filiform tips of fine acicula may just be seen. A stout yellow aciculum appears on the 18th–24th foot. The parapodia elongate posteriorly (fig. 13*e*) and the aciculum

(sometimes 2) projects further until it almost reaches the end of the conical and rather short postsetal lobe.

The above description agrees with Moore's figures and description apart from minor details. There are more teeth on the main fangs though Moore mentions some obscure crenulations 'as well as 3–4 distinct small teeth'. Hartman states that there are numerous teeth at the base of the forceps. Again Moore shows one large tooth only on Mx. III whereas here there are 2–3 denticles as well, but Hartman states that Mx. III have 4–5 smaller teeth as well as the longer one.

Monro (1936) described a specimen dredged off the Falkland Islands which he referred to *D. filum* while noting the differences from typical European forms of that species. I have examined the specimen in the British Museum, whose registered number is 1936:2:8:2355, and find it to be *D. falcata* so that the range of this species is now from California (0–172 fathoms) to 46°18′S/65°02′W (100 m.) and False Bay (18–88 m.).

Drilonereis monroi n. sp.

(Fig. 13*f–i*)

Drilonereis sp. Monro 1930, p. 142.

Records: AFR.718(1), 801(1), 1319(1), 1535(1), 1544(1), 1545(1), 1554(1), 1576(1), 1581(1); TRA.68(2), 70(1), 77(2), 88(1), 89(1); FAL.237(1), 240(1).

Description: The type was obtained from station AFR.718. It is 220 mm. long by 3 mm. broad for 250 segments. It is rusty red in colour and extremely tough and wiry. The prostomium (fig. 13*f*) is depressed, broadly triangular and lacks eyes. The pharynx usually protrudes slightly. The mandibles are lacking, there being merely toughened skin on the floor of the mouth. The maxillae (fig. 13*g*) have long filiform supports and an unusually short, shield-shaped median piece. Mx. I are stout hooks not denticulate at the base and Mx. V are missing, the formula being Mx. I = 1 + 1; Mx. II = (6–8) + (6–8); Mx. III = 3 + 3; Mx. IV = 1 + 1. On Mx. II and III the first tooth is much larger than the others.

Anterior parapodia (fig. 13*h*) are small but the feet increase in size posteriorly. There are no dorsal or ventral cirri. The presetal lobe of the foot is a low curved ridge and the posterior lobe is a short blunt cone. Between these project a sheaf of winged capillaries and a stout, blunt, yellow aciculum which is evident even on the first foot. Posterior feet (fig. 13*i*) are longer, the superior part of the presetal lobe being more expanded, and about half as long as the postsetal lobe.

The *Drilonereis* sp. described by Monro 1930 from Tristan da Cunha has been compared with these South African specimens and is identical.

This species is related to *D. nuda* Moore described by Hartman (1944) from California and *D. major* Crossland (1924) from Suez and Zanzibar, both

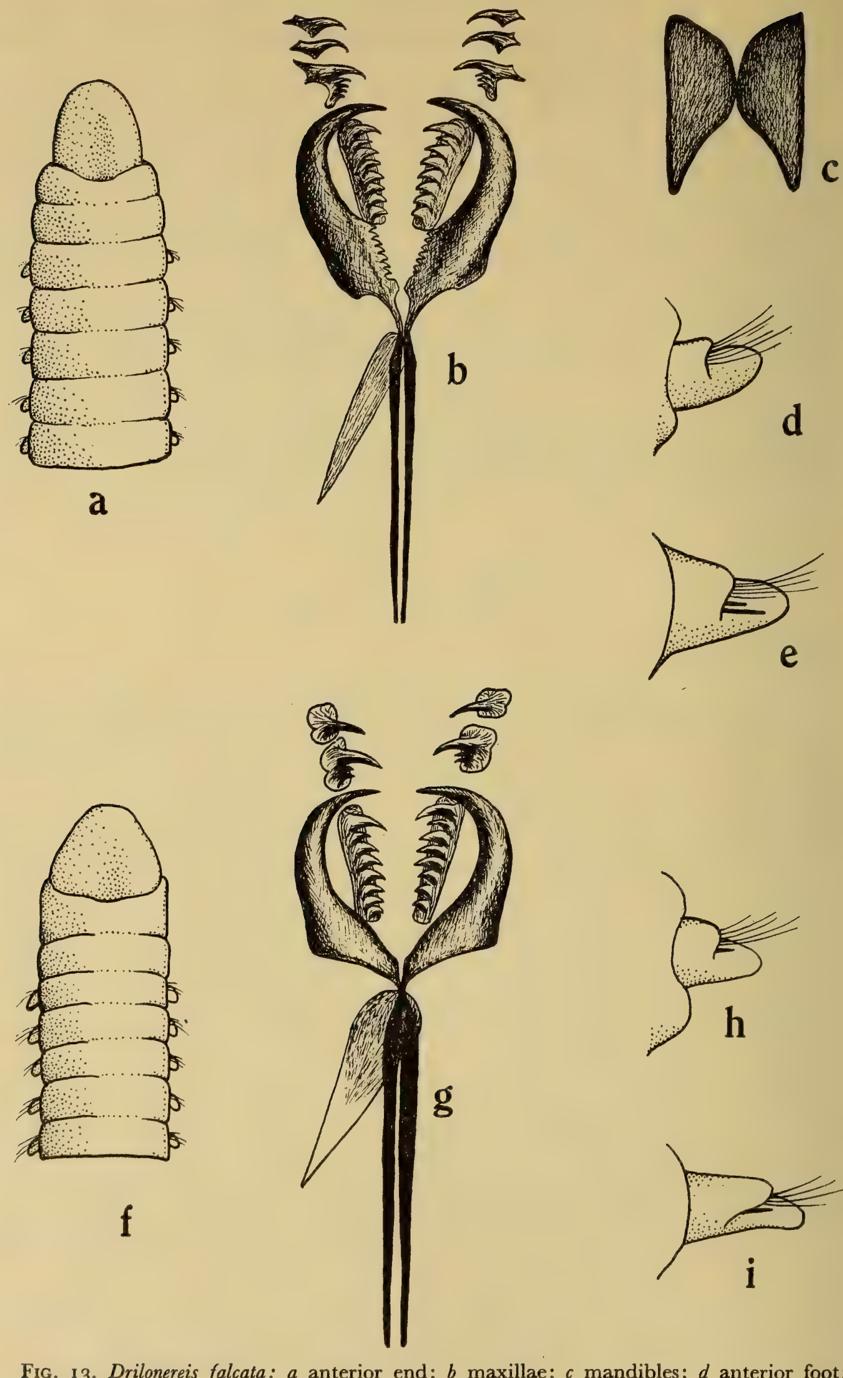

Fig. 13. *Drilonereis falcata: a* anterior end; *b* maxillae; *c* mandibles; *d* anterior foot; *e* posterior foot.

Drilonereis monroi: f anterior end; *g* maxillae; *h* anterior foot; *i* posterior foot.

of which lack distinct mandibles. It differs from *D. nuda* in not having teeth at the base of the pincers (Mx. I) and in these respects it is closer to the type of *D. major* which I have dissected and whose dental formula is Mx. I = 1 + 1 (main fangs only); Mx. II = 6 + 6; Mx. III = (3–4) + (3–4); Mx. IV = 3 + 3. However, in *D. major* the teeth on Mx. II are of fairly even size while in *D. monroi* the first tooth is much larger than the rest. There also tend to be fewer teeth on Mx. III + IV but these plates are more variable in all species. Other differences are in the setae which are always longer in *D. monroi.* Moreover the projecting aciculum of *D. monroi* appears in the first foot and in *D. major* in the 15th. It may also be noted that in the posterior feet of *D. major* the presetal lobe remains rudimentary while in *D. monroi* it becomes enlarged,— nearly as long as the postsetal lobe.

Notocirrus australis n. sp.

(Fig. 14 *a–d*)

Records: FB.306(1); FAL.229(1).

Description: The type material from False Bay includes five fragments, two anterior and three posterior ends. It is estimated that a complete worm would measure about 100 mm. by 1 mm. with about 200 segments each about three times as broad as long. The colour is uniformly pale in alcohol.

The prostomium (fig. 14*c*) is conical with 4 eyes in a transverse row at the posterior margin. The outer pair is larger than the inner pair. The jaws consist of well-developed mandibles and maxillae. Each mandible (fig. 14*a*) is strong and triangular and the two are narrowly joined in the median line. The maxillae (fig. 14*b*) consist of five pairs of toothed plates so closely crowded together that it is difficult to distinguish the teeth of one plate from those of the next; in fact plates I and II overlie one another in one specimen and in the other, plates I and II are fused on the left side. The anterior tooth of each plate is hooked and slightly larger than succeeding ones but not to the extent seen in the genus *Drilonereis*. The supports (or 'carriers') are long and slender and the median piece is very faint and pale. The maxillary formula in one specimen is Mx. I = 7 (left) + 7 (right); II = 7 + 8; III = 7 + 6; IV = 5 + 4; V = 1 + 1 and in the other where Mx. I and II are fused on the left side: Mx. I + II = 11 (left) + 7 and 9 (right); III = 9 + 6; IV = 6 + 4; V = 1 + 1.

The first two apodous segments are rather shorter than the subsequent ones, all of which bear well-developed parapodia of increasing size. Each parapodium (fig. 14*d*) has a minute, pimple-like dorsal cirrus above the setigerous lobe. The presetal lobe is rudimentary and the thumb-shaped postsetal lobe is at first almost ventral in position, but in posterior segments it moves round to the normal posterior position. Each parapodium bears about 3 winged capillaries

and a stout yellow needle-like aciculum which projects almost as far as the postsetal lobe. The capillaries have rather broad wings which are smooth except for a few serrations at the base.

The genus *Notocirrus* has most recently been reviewed by Hartman (1944). The present species is closest to *N. lorum* Ehlers from the Magellan area and *N. californiensis* Hartman from Southern California. By the courtesy of the director of the Hamburg Museum I have been able to examine Ehlers's type. Unfortunately the jaws have been removed and I have nothing that I can add to the original description. The main difference between the three species lies in the dental formula of the maxillae. As has been mentioned, these plates are small, crowded together and overlapping, and thus difficult to read. *N. lorum* is reported to have only 4 pairs of maxillary plates but Ehlers's figure 125 suggests that the 4th and 5th dental plates have not been separated. Again it may be that the left MX. II on which three teeth are shown is partially covered by (or possibly fused to) Mx. I. *N. californiensis* is very close to the present species except that Mx. II has 13 teeth on the left side and the usual minute dorsal cirrus is not figured above the parapodium. It is probable that further work will reveal that the maxillae are more variable than has been suspected and a number of species will be sunk in the synonymy.

Fauvel (1923, p. 451) regarded *N. scoticus* McIntosh 1869 as a doubtful species but a re-examination of the type material now in the British Museum (registered numbers 1921-5-1-1681-86) shows that it is definitely a *Notocirrus* though McIntosh's description of the structure of the feet is very confused due to his having inverted his preparation. Thus what he described as a dorsal cirrus is really the postsetal lobe, and what he referred to as a ventral cirrus is really the dorsal cirrus. According to Ehlers (1875, p. 55), *N. scoticus* is a synonym of *N. tricolor* (Johnston) 1865. A brief summary of the characters of the type of *N. scoticus* may now be given. Body brown, rather small for the genus and segments markedly moniliform for the segments are about as broad as long with deep intersegmental constrictions between one and the next. Prostomium conical with two pairs of eyes which fade in alcohol. Jaws consist of a pair of well-developed, triangular mandibles and 4–5 maxillary plates with the usual long supports. The dental formula is doubtful. McIntosh (1910) gives a drawing (p. 62, fig. 9*a*) which shows a number of larger and smaller teeth which may be variously interpreted. One interpretation is Mx. I = (left) 7 + (right) 8; Mx. II = 12 + 7; Mx. III = 6 + 7; Mx. IV = 5 + absent; Mx. V = 1 + absent. The dental apparatus on which his drawing was based has not been preserved; indeed all the jaws of the type material are missing except one from the Porcupine Expedition (registered number 1921-5-1-1685). These jaws are very small and, as usual, difficult to read. My reading is Mx. I = (left) 7 + (right) 8; Mx. II = 6 + 7; Mx. III = 5 + 5; Mx. IV = 3 + 4; Mx. V = doubtful. It will be obvious that the dental formula quoted depends on the inclusion or omission of minute or partially formed denticles on the maxillary plates quite apart from individual variation. The distinction between

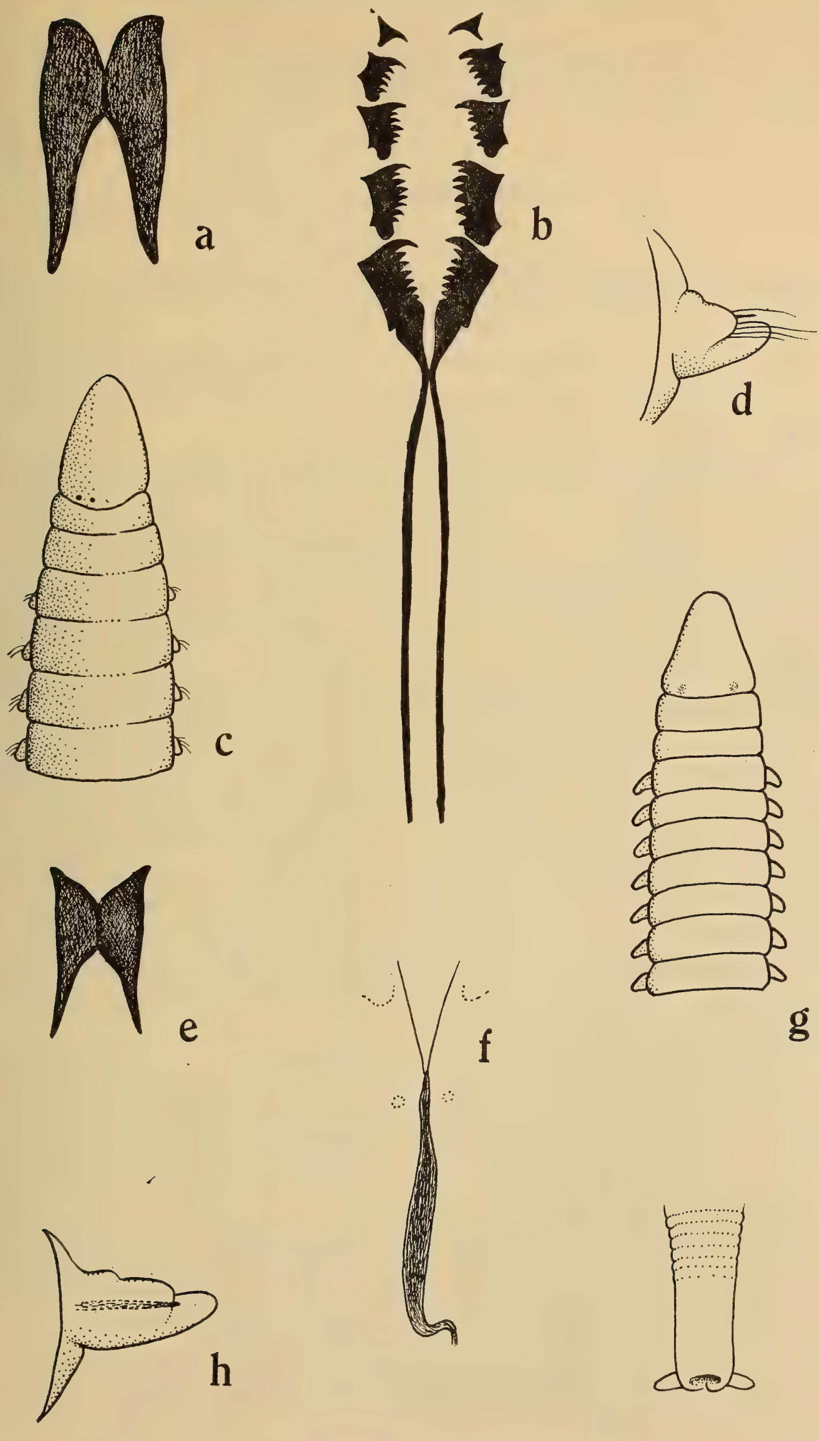

FIG. 14. *Notocirrus australis: a* mandibles; *b* maxillae; *c* anterior end; *d* middle foot. *Drilognathus capensis: e* mandibles; *f* vestiges of maxillae; *g* anterior end; *h* middle foot; *i* posterior end.

individual species of the genus *Notocirrus* rests largely on the dental formula so that one becomes sceptical as to whether there really are several species and not one world-wide one.

Drilognathus capensis n.g. et sp.

(Fig. 14 *e–i*)

Records: 5 specimens found in the body cavity of *Onuphis holobranchiata* dredged in Lamberts Bay 18.1.57 (station LAM.11).

The holotype is a complete specimen which is twisted, but if straight would measure about 3 mm. by 0·3 mm. with about 60 segments. The whole worm is creamy white, and is tapered posteriorly.

The prostomium (fig. 14*g*) is well marked off from the succeeding segment. It is ovoid, somewhat tapered anteriorly and lacks appendages. No eyes are visible on the surface but when cleared in glycerine two eyes are visible posteriorly. Dissection of one specimen showed that the mandibles (fig. 14*e*) are well developed and black. They are of the usual *Drilonereis* type and there is no sign of the recurved rostra which has been described for *Labrorostratus parasiticus*. The maxillae (fig. 14*f*) are represented by a blacked cuticular ridge on the dorsal wall of the pharynx. The length of this black cuticular streak is reminiscent of the long maxillary supports of *Drilonereis* and *Arabella* but no fangs or distinct maxillary plates were seen.

The first two segments lack parapodia. Each of these achaetous segments is about 4 times as broad as long. Succeeding segments up to the middle of the body have well-developed parapodia (fig. 14*h*) of the usual *Lumbrinereis* type, though the presetal lobe is rudimentary and even the postsetal lobe is no more than a blunt cone. From the middle of the body onwards the parapodia are progressively reduced, first to mere lateral papillae and eventually over the last 10–15 segments they are entirely lacking. The pygidium however is well developed (fig. 14*i*) and has a pair of large ventro-lateral lobes projecting outwards at right angles to the body.

Each parapodium is supported by a stout aciculum of the *Drilonereis* type. It is a bluntly pointed yellow needle which in most parapodia seems not to pierce the skin, but in some it does, and then just projects in front of the postsetal lobe. There are no other setae, a fact which immediately distinguishes this species from related genera.

Pettibone (1957) gives a most useful key to endoparasitic members of the Arabellidae. It is with considerable hesitation that I name this as a new genus, for according to Pettibone the young stages of *Notocirrus* occur as parasites in the Onuphidae and Pettibone's figures 5L and M of the jaws of *Notocirrus* ? *spiniferus* are not unlike those of the present specimens. However, all the other genera that have been described have setae in the parapodia whereas *Drilognathus* has merely a well-formed aciculum.

Subfamily Dorvilleinae

Dorvillea neglecta (Fauvel) 1923

Staurocephalus neglectus Fauvel 1923, p. 447, fig. 179 *i–q*.
Dorvillea neglecta Day 1953, p. 439.

Records: SB.183(1); SH.366(1).

Dorvillea egena (Ehlers) 1913

Stauronereis egena Ehlers 1913, p. 501, pl. 35, figs. 1–6. Augener 1918, p. 377, pl. 5, fig. 102, 103, text-fig. 40.

Records: FAL.284(1).

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MODERN GIRAFFES AND THE FOSSIL GIRAFFIDS OF AFRICA[1]

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CONTENTS

GENERAL INTRODUCTION

With the discovery of several large fossilized giraffid teeth (Singer, 1954) and, later, of a pair of horn cores (so-called 'palmated antlers') on the large exposed sand-duned fossiliferous site on the farm 'Elandsfontein' near Hopefield (60 miles north-west of Cape Town), it was found necessary to compare these specimens with others found in Africa. During this study, it became obvious that a complete survey and review of the numerous genera of fossil giraffids found on the continent was essential. On surveying the literature, very little information on the extant *Giraffa camelopardalis* was found. Consequently a large number of skeletons of the extant animal were studied in the American Museum of Natural History (New York), in the Chicago Natural History Museum, in the U.S. National Museum (Washington, D.C.), in the Department of Comparative Zoology at Harvard University, in the Musée Royal du Congo Belge (Tervuren, Brussels), and in the South African Museum, Cape Town, so as to obtain statistically significant ranges of variation of intra-specific

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characters which would be of value in assessing the fossil specimens. This paper is consequently divided into three* portions, the first dealing with observations on the modern giraffes, the second containing observations on the fossil material assembled in Cape Town or studied in the British Museum (Natural History), the Muséum d'Histoire Naturelle (Paris), and the Coryndon Museum, Nairobi, while the third section contains the discussion and conclusions.

SECTION I

SURVEY OF THE LIVING GIRAFFE

Introduction

In the literature numerous references are made to various subspecies of *G. camelopardalis*. These distinctions are based on skin colour pattern and on horn-core differences (Lydekker, 1904). Owing to the fact that the skins of the extant specimens studied were not preserved in most cases, no correlation with the skeletal material was possible, but the study of the horn-cores (*vide infra*) indicated that no substantial subspecific differences could be detected, and consequently it was considered reasonable to treat the material as a whole in a specific determination. As a result of the observations made and the wide range of variation of the data obtained for the whole group, it is suggested that the diagnostic criteria for subspecies of *G. camelopardalis* should not be based on skin colour patterns alone as these may be ecological variables. In this respect, it is interesting to observe in the list of extant specimens examined (Chapter 2) that the deficiencies in the information regarding the subspecies in Museum records are due to the fact that no accurate diagnosis was possible on the basis of the skeleton alone when no skin was received.

CHAPTER I

GENERAL DESCRIPTION OF THE GIRAFFID DENTITION

(Applicable to modern giraffes and extinct giraffids.)

While almost all the Eocene Ungulata possess the full mammalian dentition ($I\frac{3}{3}\ C\frac{1}{1}\ P\frac{4}{4}\ M\frac{3}{3} = 44$), maxillary incisors and canines as well as anterior upper and lower premolars and posterior molars have been lost in the course of the evolution of the Giraffidae, so that all recorded fossil material already possess the formula of the extant giraffes, viz. $I\frac{0}{3}\ C\frac{0}{1}\ P\frac{3}{3}\ M\frac{3}{3} = 32$. The mandibular incisors must have occluded —as in the modern Pecora—against a hard elastic pad of the gum. Parallel to this reduction in the number of teeth, a great development of the cheek-teeth is observed, as well as a marked tendency to hypsodonty (less noticeable in the modern species), both characters making the dental apparatus suitable for a herbivorous diet, which

* A fourth portion, the Appendix, was added later.

requires a great amount of mastication. In the general pattern of the teeth, there is no essential difference between fossil and extant Giraffidae, although quite a few of the fossil genera have got much larger teeth as well as minor variations in structure. As far as it can be judged from the extinct material available, the whole family is characterized by a brachy- to hypsodont, selenolophodont type of molar. In all specimens, the third lower molar has an accessory posterior lobe or talonid. The somewhat cuboid crown of the molars presents on its occlusal surface—even before any marked wear—a longitudinal fold, extending across the summit mesio-distally, and a transverse cleft extending bucco-lingually, dividing the tooth into an anterior and a posterior lobe or pillar. The external surface presents two vertical grooves running from the grinding surface to the root, the buccal one being by far the deepest in the lower molars, the lingual one in the upper; the less marked groove on either surface is actually nothing more than the lateral depression resulting from the formation of a mesostyle by an elevation of the cingulum (*vide infra*). Each of the pillars of the molars are slightly angulated through their transverse axes to the main longitudinal axis of the jaw so that the former axes are rotated anteriorly and medially: the anterior portion or pillar of a particular molar lies more laterally (buccally) than the posterior pillar of the preceding molar.

It is not essential here to present details and discussion about the origin of the Ungulate tooth and its components, but a brief description of the structure of the giraffid tooth is justified for the sake of clarity.

In earlier mammalian forms, trigone and talon distinguish between cutting and crushing portions of the crown, but the trigone is lowered in Ungulates to the level of the talon. Four main primary cusps may be recognized in the molars, while a fifth one, derived from the cingulum, has probably been established very early as a further crown cusp. These five *cones* (or *conids* in the lower molars), which are elevations of the grinding surface of the tooth, eventually become separated from one another by small secondary and intermediate cusps, *conules* or *conulids*. The periphery of the base of the crown, or *cingulum*, encircles the neck of the tooth: it is well or little developed, depending on a rather wide individual variation. Nevertheless it is nearly always present and commonly gives origin to peripheral cusps, called *styles* or *stylids*. In this paper, cusps are named according to the tritubercular theory of Osborn (1892), but this does not necessarily indicate that there is an acceptance of all its broad phylogenetic implications. As this paper is exclusively devoted to Giraffids, the main purpose of utilizing Osborn's nomenclature is to provide a clear description of morphological features. However, in this respect, the suggestions of Arambourg (1947) are very helpful, because his amended nomenclature may be applied both to molars and premolars. Main cusps will therefore be called *cones* or *conids*. The medial (lingual) ones are, in the upper teeth, from front to back (mesio-distal), the *protocone* and the *hypocone*, in the lower teeth the *paraconid*, the *metaconid* and the *entoconid* (fig. 1). The lateral (buccal) cusps are, respectively, the *paracone* and the *metacone*, and the *protoconid* and the *hypoconid*. Secondary cusps in the upper teeth are the intermediate *paraconule* and *metaconule*, derived from elevations of the crown, and, in the lower, the *hypoconulid*. Other secondary cusps

are also derived from elevations of the cingulum, viz. the lateral *parastyle*, *mesostyle* and *metastyle*, and the *protostylid*, *ectostylid* and *hypostylid* of upper and lower molars respectively, while on the medial side are the *protostyle*, *entostyle* and *hypostyle*, and the *parastylid*, *metastylid* and *entostylid* on the upper and lower teeth respectively.

In the Ungulate type of tooth, especially among Pecora, several cusps or *styles* lose their individuality and fuse into crests or ridges or *lophs*. These are built up of

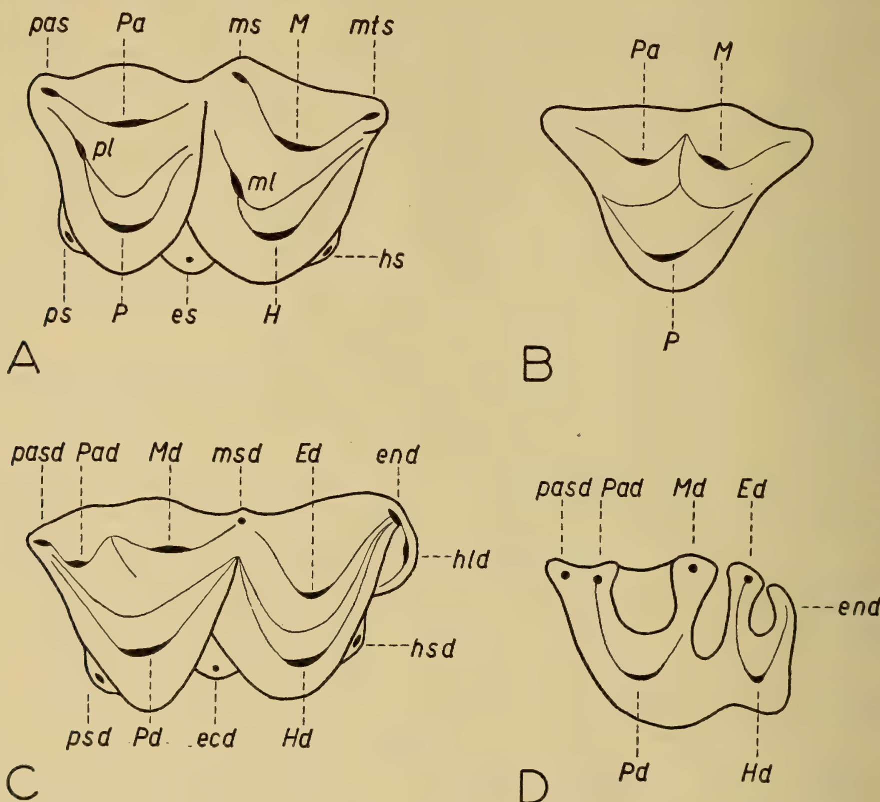

FIG. 1. Schematic representation of giraffid molar and premolar nomenclature (after Arambourg, 1947).
A, upper molar. B, upper premolar. C, lower molar. D, lower premolar.

			Upper jaw		*Lower jaw*	
Main cusps	*Internal*	1.	Protocone	P	Paraconid	Pad
		2.	Hypocone	H	Metaconid	Md
		3.			Entoconid	Ed
	External	1.	Paracone	Pa	Protoconid	Pd
		2.	Metacone	M	Hypoconid	Hd
Secondary cusps	*Median* anterior		Paraconule	Pl		
	posterior		Metaconule	ml	Hypoconulid	hld
	External	1.	parastyle	pas	protostylid	psd
		2.	mesostyle	ms	ectostylid	ecd
		3.	metastyle	mts	hypostylid	hsd
	Internal	1.	protostyle	ps	parastylid	pasd
		2.	entostyle	es	metastylid	msd
		3.	hypostyle	hs	entostylid	end

two or more cusps and are ordinarily very marked, so that *protoconule* and *protocone*, *metaconule* and *hypocone*, *parastyle*, *paracone*, and *mesostyle*, and *mesostyle*, *metacone* and *metastyle* (or corresponding *conids* and *stylids* in the lower tooth) are fused forming four of these crescentic ridges or 'crescents', the former two being more curved, and the concavity of the crescents facing the buccal or lingual surface of the tooth in the upper and lower molar, respectively. This double-pillared and double-crescentic crown is the typical simple ruminant pattern and determines the seleno-lophodont type of Giraffid tooth.

Prolonged into the depth of the crown by their enamel coat, the two parallel rows of cusps and their linking crests [the buccal and the lingual, i.e. the *proto-hypoloph* (*metaloph*, Osborn, 1907) and *ectoloph*] build the side-walls of the *infundibulum*, central pit or valley, poorly lined by cement (*crusta petrosa*) in Giraffids, which becomes stained by the food and constitutes the so-called *mark* (*Marken*, Bohlin, 1926; *marque*, Arambourg, 1947). The *infundibulum* is itself festooned along the mesio-distal axis of each pillar, and is contiguous in the transverse cleft with the central pit of the adjacent pillar before any advanced wear takes place. When unworn, the crescentic ridges are very well marked. With the gradual wear of the pointed enamel crests, however, the apex of each *loph* tends to be levelled mesio-distally while the *lophs* broaden in the bucco-lingual axis. An increasing crescentic tract of dentine shows between the two newly formed lips of enamel which progressively separate from one another; at that time the *infundibulum* or central pit narrows by approximation of the buccal and lingual lips of the adjacent walls of the crescents. In very worn teeth, the pit may be restricted to a simple ridge of enamel, circular (island of enamel) or linear, which represents the actual fusion line of the side walls of the *infundibulum* in the depth of the crown, or the enamel of the pit may even disappear completely.

It has often been observed and mentioned (already by Owen, 1840–5) that in the giraffe, the median convexity (*costa*) of the buccal surface of the anterior pillar in upper teeth (inner or lingual surface, in lower teeth) is more prominent nearer the occlusal end of the crown than nearer the base, while the vertical ridge of the *meso-style* (*-stylid*) projects outwards from the surface of the tooth more than the median *costa* of the *metacone* (or *entoconid*). This feature is quite consistent throughout the family, and is distinctly recognized in the fossil material from the Siwaliks, India, as well as in the specimens presently studied (*vide infra*).

The upper molars differ from the lower molars in their general shape, the breadth or transverse (bucco-lingual) diameter approximating or even surpassing the length or antero-posterior (mesio-distal) measurement.

As in most artiodactyls, the premolars are unilobed. However, in the fossil specimens the last lower premolar has a clear demarcation of the posterior portion of the tooth.

The incisors describe a semicircle, although in most ruminants they are arranged in a straight transverse line at the extremity of the jaw. The canines have been profoundly modified in shape and position and resemble very much a fourth pair of incisors; however their crown is larger, much more triangular and somewhat bilobed.

All the teeth are covered by a coat of relatively very rugose enamel, both on the extant and fossil specimens. This feature is characteristic of the group. The maximum rugosity is always observed on the medial surface of the *protocone* and *hypocone*, and on the lateral surface of the *protoconid* and *hypoconid*.

Incisors and canines are implanted by a single root which slopes backwards horizontally. The lower teeth have two roots, an anterior and a posterior one; all the upper teeth have three roots, two lateral and one medial. However, both anterior and posterior roots of the lower molars as well as the medial root of the upper molars show a tendency of fusion of two fangs. They are broadened, flattened from side-to-side or bucco-lingually, and present a median groove, the groove being on the lingual surface in the upper, while in the lower the groove on one root faces that on the other, the deeper groove being on the anterior root.

CHAPTER 2

LIST OF RECENT *GIRAFFA CAMELOPARDALIS* STUDIED

The observations recorded below on the extant material were made on the following specimens, for which the number, age, sex, origin and subspecies have been extracted directly from the registers of the respective museums. Gaps in the information below indicate deficiencies in the registers.

I. U.S. NATIONAL MUSEUM, WASHINGTON, D.C.

No.	*Subspecies*	*Age*	*Sex*	*Origin*
14411	*G.c. camelopardalis*	I(1)	—	—
121010	*G.c. rothschildi*	A(1)	M	Lake Baringo, B.E.A.(2)
154033	*G.c. capensis*	I	M	Matabeleland, Rhodesia.
155438	*G.c. rothschildi*	A	M	Guas Ngishu Plains, B.E.A.
162016	*G.c. tippelskirchi*	A	—	Kilima Kui Kapiti Plains, B.E.A.
162017	*G.c. tippelskirchi*	A	M	Kilima Kui Kapiti Plains, B.E.A.
162018	*G.c. tippelskirchi*	A	M	Ulu Station, B.E.A.
162988	*G.c. tippelskirchi*	A	F	Sotik, Gnaso Nyiro, B.E.A.
162989	*G.c. tippelskirchi*	I	F	Sotik, Gnaso Nyiro, B.E.A.
163112	*G.c. rothschildi*(3)	I	M	Guas Ngishu Plateau, B.E.A.
	G.c. tippelskirchi	I	M	Sotik, Gnaso Nyiro, B.E.A.
163113	*G.c. reticulata*	A	—	Gnaso Nyiro, B.E.A.
163312	*G.c. rothschildi*	A	—	Guas Ngishu Plateau, B.E.A.
163324	*G.c. reticulata*	A	F	N. Gnaso Nyiro, B.E.A.
182124	*G.c. reticulata*	A	—	Koga Water, B.E.A.
182125	*G.c. reticulata*	A	—	Marsabit Road, B.E.A.
182192	*G.c. reticulata*	A	—	Lakiundu River, B.E.A.
200151	*G.c. rothschildi*	A	M	Wasin Gisher Plateau, B.E.A.
251797	*G.c. tippelskirchi*	A	F	Savanda, Dodoma, Tanganyika.
251798	*G.c. tippelskirchi*	A	—	Dodoma, Tanganyika.
251799	*G.c. tippelskirchi*	A	—	Mkata Plains, Tanganyika.
251800	—	A	—	—
252549	—	I	M	Sudan (Nat. Zool. Park).
252585	—	I	F	Sudan (Nat. Zool. Park).
270594	*G.c. reticulata*	A	F	— (Nat. Zool. Park).
279405	—	9 years	M	— (Nat. Zool. Park).
296145	—	A	—	S.W.A.(2), Gaucha (about 19° 47′ S. 20° 35′ E.).
299998	*G.c. camelopardalis*	I 5 months 26 days	M	— (Nat. Zool. Park).

II. CHICAGO NATURAL HISTORY MUSEUM

No.	*Subspecies*	*Age*	*Sex*	*Origin*
27475	—	I	M	Northern Uganda.
29515	—	I	F	Kenya.
32901	*G.c. reticulata*	A	F	Abyssinia, Sidamo, Boram Border.
32902	—	A	F	Abyssinia, Sidamo, Boram Border.
32904	*G.c. reticulata*	I	M	Abyssinia, Sidamo, Boram Border.
32905	—	I	M	Abyssinia, Sidamo, Boram Border.
34422	—	A	M	Bechuanaland, Mababe Flats.
34423	—	A	F	Bechuanaland, Mababe Flats.
34424	—	A	F	Bechuanaland, Mababe Flats.
34425	—	A	M	Bechuanaland, Kalahari Desert, Kwaai, Mokaba River.
34426	—	A	F	Bechuanaland, Mababe Flats.
34427	—	I	F	Bechuanaland, Mababe Flats.
34428	—	I	M	Bechuanaland, Mababe Flats.
34429	—	A	F	Bechuanaland, Mababe Flats.
34930	—	A	M	Kenya.
53765	*G.c. reticulata*	A	M	—
54251	—	I	M	Tanganyika (Zoo).
X_3 (4)	—	A	—	—

III. COMPARATIVE ZOOLOGY MUSEUM, HARVARD UNIVERSITY

8370	*G.c. tippelskirchi*	A	—	East Africa.
8371(5)	—	A	—	—
8372(5)	—	A	—	—
14564	*G.c. tippelskirchi*	A	—	B.E.A.
15698	—	A	—	Sudan, Dinder River, near Kuka-Dindu.
27137	—	A	—	East Africa.

IV. AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK

20884	—	I	F	—
24290	—	A	—	Bechuanaland.
24291	—	A	—	Bechuanaland.
24292	—	A	—	Bechuanaland.
24293	—	A	—	Bechuanaland.
27675	—	A	—	Kenya.
27752	*G.c. rothschildi*	A	—	B.E.A.
27753	*G.c. rothschildi*	I	—	B.E.A.
35536	—	A	M	—
35628	—	I	—	—
53543	*G.c. congoensis*	A	F	Belgian Congo.
53544	*G.c. congoensis*	I (Foetus)	—	Belgian Congo.
53546	*G.c. congoensis*	A	F	Belgian Congo.
53548	*G.c. congoensis*	I	M	Belgian Congo.
53549	*G.c. congoensis*	A	F	Belgian Congo.
54122	*G.c. tippelskirchi*	I	M	B.E.A.
54123	*G.c. tippelskirchi*	A	M	Northern Gnaso, Nyiro.
57675	—	A	—	—
69403	—	I	—	—
80146^1 (6)	—	I 7 months	M	(New York Zoo)
80146^2 (6)	—	I	—	—
81820	—	A	—	—
81821	—	A	—	—
81822	—	A	—	—
81823	—	A	—	—
81824	—	A	—	—
81825	—	I	—	—
81826	—	I	—	—

No.	*Subspecies*	*Age*	*Sex*	*Origin*
82001	—	A	M	Kenya.
82002	—	A	F	Kenya.
82003	—	I	—	Kenya.
83458	—	I	F	Bechuanaland, Mababe Flats.
83459	—	I	F	Bechuanaland, Mababe Flats.
83460	—	A	M	Bechuanaland, Mababe Flats.
83605	—	I	—	Southern Rhodesia, east of Ngamo Station.
99493	—	A	M	Nubia (23 years in a zoo).
139695	—	A	—	—
139696	—	A	—	—
144915	—	A	—	(Central Park Zoo, N.Y.).
165051	*G.c. capensis*	I	M	S.W.A., Etosha Pan, Farm Lombard.
165052	*G.c. capensis*	I	F	S.W.A., Etosha Pan, Farm Lombard.
X_1 (7)	—	A	—	—
X_2 (7)	—	A	—	—
X_4 (7)	—	A	—	—

V. SOUTH AFRICAN MUSEUM, CAPE TOWN

M. 245	—	I	—	—
17176	—	A	—	—
—	—	A	—	—

VI. MUSÉE ROYAL DU CONGO BELGE (TERVUREN, BRUSSELS)

R.G. 4947	*G.c. congoensis*	A	—	Uele.
R.G. 4948	*G.c. congoensis*	A	—	Uele.
R.G. 4949	*G.c. congoensis*	A	M	N.E. Uele; sources of Garamba River.
R.G. 6342	*G.*	A	—	Ufipa district.
R.G. 2128	*G.c. schilbergsi*	A	—	B.E.A., Serengeti Plains.

(1) 'I' signifies immature; 'A' = adult.

(2) B.E.A. signifies British East Africa; S.W.A. = South West Africa.

(3) The same number has been given to the skull and the jaws. Although they obviously belong to the same individual, the skull is labelled '*rothschildi*' and the jaws '*tippelskirchi*', and they have been given different places of origin.

(4) This specimen has no Collection number. This indication is ours.

(5) Although skull and jaws have the same number they do not belong to the same individual.

(6) These two specimens have the same number. We refer to them as (1) and (2).

(7) These three specimens are not registered. We refer to them as X_1, X_2 and X_4.

CHAPTER 3

OBSERVATIONS ON TOOTH ERUPTION AND CRANIAL SUTURES

Among the specimens examined, a group of 32 immature individuals forms a rather complete series of the various juvenile and adolescent stages of growth. In describing this series, the sequence of tooth eruption and cranial suture synostosis, and some data concerning the milk dentition and the growth pattern are particularly emphasized.

From the information available, it is possible to extract the subspecies of *Giraffa camelopardalis* in 12 cases: *camelopardalis* (2), *rothschildi* (2)*, *tippelskirchi* (2), *congoensis*

* The same number (U.S. Nat. Mus. 163112) has been given to the skull and the jaws. See note (3) in legend in previous chapter.

(2), *reticulata* (1) and *capensis* (3). As far as the sex is concerned, 10 specimens were registered as female, 13 others as male. As regards their origin, it is known that 8 animals derive from British East Africa, 2 from Sudan, 2 from Ethiopia (Abyssinia), 2 from the Belgian Congo, 2 from Southern Rhodesia, 4 from Bechuanaland and 2 from South West Africa. Some specimens of unknown origin had been received from zoological gardens or veterinary colleges. The ages extend from the foetal period to the sub-adult stage. Information concerning the precise age of two specimens were found in the Museum registers, viz., specimens 299998 and 80146[1] which are 5 months 26 days and 7 months old respectively; unfortunately the latter animals were born, reared and then died in zoos. It is quite likely that conditions of captivity affected the growth tempo, and data concerning these must be evaluated with care before using them as age standards.

A. Tooth eruption

In the group of immature animals 826 teeth were available for study (table 1). In this number are also included the sockets of missing teeth. Furthermore, although

Permanent Dentition	I_1	I_2	I_3	C	P^2	P_2	P^3	P_3	P^4	P_4	M^1	M_1	M^2	M_2	M^3	M_3
(411)	22	16	12	6	18	14	19	18	18	18	58	54	44	42	26	26

Milk Dentition	i_1	i_2	i_3	c	DM^2	DM_2	DM^3	DM_3	DM^4	DM_4
(415)	32	36	44	48	42	42	42	42	45	42

Table 1. Number of teeth examined in the immature giraffes.

some of the teeth were either broken or incompletely erupted, valuable information was gained from observations on either their roots or their sockets. Accurate measurements could be made on 331 perfectly preserved milk teeth. The stage of eruption of the dentitions is indicated in table 2 and figure 2.

Erupting Tooth	Stage 1	Stage 2	Stage 3	Stage 4	Absolute Age
DM3	53544				Foetus
M1	163112		299998	14411	6 months
	34428		82003		
			80146[2]		
			83459		
M2		252549		162989	7 months
		252585		53548	
		80146[1]		54122	
		54251		81826	
M3—I1	165052	29515	83605	81825	
	20884				
P4, P3, P2	35628			69403	
	27753				
I3	154033			34427	
	165051				
C	27475			32905	
	83458				

Table 2. Stage of eruption of individual teeth. The appearance of the tooth at the surface of the bony alveolus is stage 1, while stage 4 indicates complete eruption of the crown. Stages 2 and 3 are equally spaced intermediate phases.

The observations on the state of eruption and wear lead to the following conclusions:

1. For both the milk and permanent dentitions (with the exception of DM^4, *vide infra*), the upper teeth erupt slightly before the corresponding lower teeth. The priority of eruption of a particular upper tooth was observed in 16 of the 18 cases (from 13 different individuals) where the difference between the time of eruption of a tooth in the upper and of a corresponding time in the lower jaw (here called 'asynchronism') could be traced, namely, for M1—80146², 82003, 83459; for M2—81826, 53548 and 54251; for M3—81825, 83605, 165052 and 29515; for P2—27753 and 35628; for P3—27753, 35628 and 83605; and for P4—30628. In only two cases the lower tooth has erupted shortly before the corresponding upper tooth, viz. in 69403 (P_2) and 299998 (M_1). In no case, however, is the asynchronism too marked: in the above 18 cases, the more precocious tooth is never fully developed before the lower one starts erupting. Four degrees of actual eruption are defined from the first appearance of the tooth on the alveolar surface (stage 1) to its final development (stage 4); two intermediate stages (stages 2 and 3) of progressive eruption are interposed. The state of development prior to any eruption is termed stage 0. In 17 of the 18 cases the degree of asynchronism does not exceed one unit (i.e. 0—1, 1—2, 2—3, 3—4), while in only one case, viz. the P3 of 35628, is the difference between the stage of eruption of the upper and the lower tooth 2 units (1—3). It is not easy to evaluate the absolute duration (in terms of days, weeks, etc.) of the asynchronism. Eruption may be a rather rapid process because in one particular case (35628), the milk molar DM^4 is still fixed on the summit of a fully erupted P^4. No conclusions can be drawn whether there is lack of asynchronism of eruption between right and left corresponding teeth in a maxilla or mandible. The evidence suggests that they erupt synchronously (fig. 2).

2. The complete milk dentition is *in situ* and is already functional before the first permanent tooth (M^1) erupts, e.g. 80146², 82003, 83459, 163112, 299998, 14411 and 34428. The first two incisors i_1 and i_2 probably precede the appearance of the first milk molar. Only one specimen of the collection (53544) is at such an early stage, but because it is rather badly preserved it is not possible to draw a definite conclusion. The first two incisors are perfectly formed and fully erupted before DM_4 begins to come through, but the evidence is not sufficient to ascertain the relationships of i_3 and the canine, although specimen 32904 suggests that the latter appears immediately after all the milk molars have erupted.

3. The milk molars erupt in rather regular succession, posterior to anterior in the mandible, DM_4 preceding DM_3, which in turn precedes DM_2, as in specimen 80146² and 53544. Furthermore, the latter is still a foetus and indicates that the whole milk dentition is formed before parturition. The succession is reversed for the maxilla, as judged from specimen 80146² where the eruption starts with DM^2. On the other hand the six upper and lower milk molars seem to erupt simultaneously in specimen 32904, so that one cannot generalize dogmatically on the basis of this small series.

4. The permanent molars of both upper and lower jaws erupt in the same order, i.e. from anterior to posterior: M1 precedes M2 in 14 cases (53548, 80146[1], 80146[2], 81826, 82003, 83459, 14411, 163112, 252549, 252585, 299998, 162989, 34428

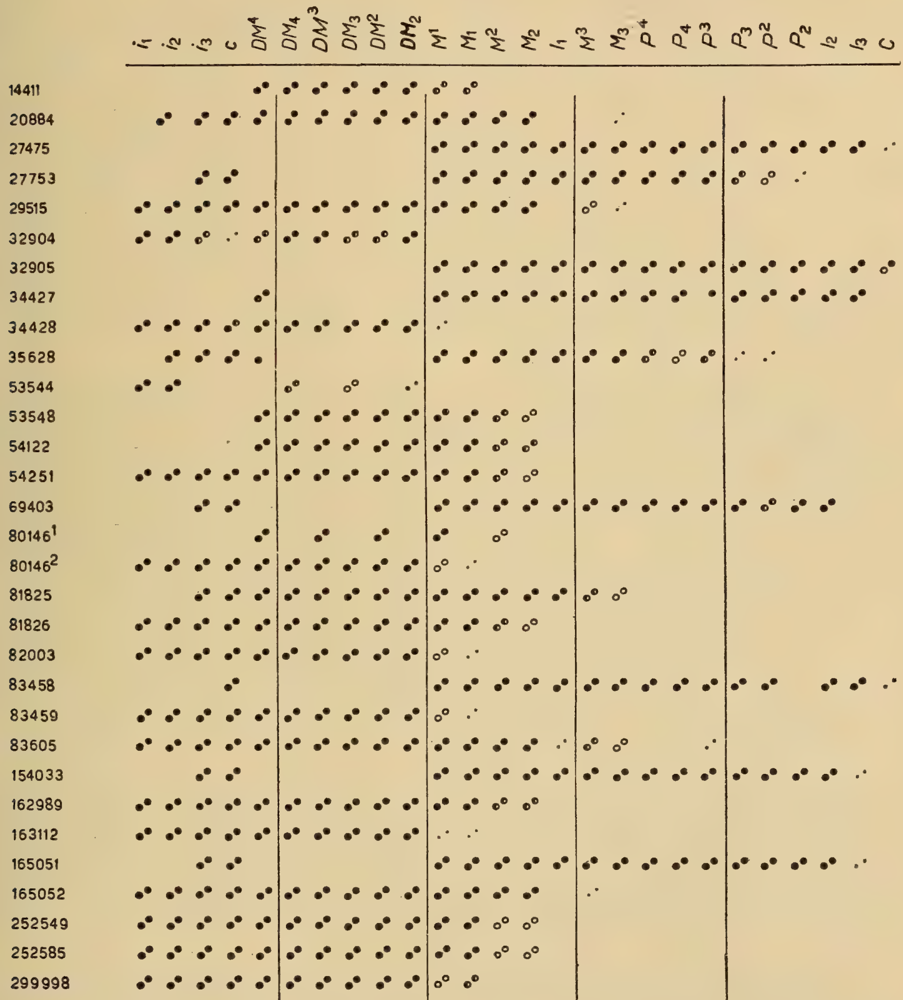

Fig. 2. Stages of eruption of individual modern giraffe dentitions (upper and lower, left and right sides).
. — Stage 1. ○ — Stage 2. ◐ — Stage 3. ● — Stage 4.

and 54251), and M2 precedes M3 in 13 individuals (20884, 53548, 54122, 80146[1], 81825, 81826, 83605, 165052, 252549, 252585, 162989, 54251 and 29515). No exception to this order was found.

5. The replacement teeth of the milk molars, the premolars, usually appear

immediately after the eruption of the last permanent molar, i.e. M3, and never before it. In one case, however, M3 (83605) is still in the process of eruption (stage 3) when P3, the first actual premolar to erupt, already cuts through the alveolar border. The sequence of appearance of the premolars is less rigid than the eruption order of the molars. In the four cases where the observation was possible (25628, 69403, 27753 and 165051), P2 is later than P3; in a fifth case (83458) P2 is bilaterally absent in the mandible, and this might be considered as an extreme of the normal late eruption of P2. In quite a few adult specimens, the same congenital absence of P2 was observed (e.g. 83460, lower left), or alternatively, there is a marked reduction of P2 where the root is abnormal (single) and the body slightly shorter (A—P) than usual (83460, 34423 and 34424). While P4 precedes P3 in two cases (27753 and 35628), P3 erupts before P4 in one specimen (83605). Consequently, it may be concluded that the premolar eruption sequence is variable, but that the whole process of eruption must be rather brief. These small individual differences have probably no or little functional influence or significance.

6. The permanent incisors erupt at the same time as the molars and premolars. In this respect, useful information is provided by 13 mandibles. I_1 starts erupting during the eruption and maturation of M_3 (83605), and it is always present when M_3 has completed its growth (27753, 35628, 69403, 81825, 83458, 83605 and 165051). It might erupt slightly before M_3 (81825); usually, however, it does so immediately after (83605 and 165052). I_2 appears later and never erupts before I_1 or before the full development of all the molars and premolars (27753 and 35628); in both cases, for example, the milk incisor i_2 is still *in situ* when the last erupting premolar (P_2) comes through. On the other hand, specimen 69403 has a perfectly developed I_2 while P_2 is still erupting, which would suggest that both teeth erupt practically simultaneously, unless one considers it as an abnormal delay in P_2 eruption (it being the only recorded case where the upper tooth is slower than the corresponding lower one, and P_2 is in fact perfectly and completely developed). I_3 can be found, though still in eruption, on three specimens (83458, 154053 and 165051) which already have their two other incisors and all their molars and premolars. I_3 is still lacking in four other individuals which have all their premolars (27753, 35628, 69403 and 83605). Consequently, it indicates that the eruption of the lateral incisor I_3 occurs after that of all the other permanent teeth, except the canine.

7. The permanent canine was found in only three specimens of the immature collection (83458, 32905 and 27475). In one of these, it erupts directly under the milk canine which is still *in situ*, all the other permanent teeth being perfectly developed. This animal died during the transition from a sub-adult to an adult stage as is indicated by the fact that the canine is the last tooth to complete the dentition of the giraffe.

Figure 3 illustrates a schematic and summarized view of the above information as well as an attempt to determine the absolute age of tooth eruption in modern giraffes (data completing and correcting Owen, 1840–5, and 1849, as well as Lankaster, 1907).

B. Cranial suture and tooth eruption

In the same group of immature giraffes observations were made on eight sutures: fronto-sagittal, fronto-parietal, inter-parietal, temporo-parietal, temporo-occipital,

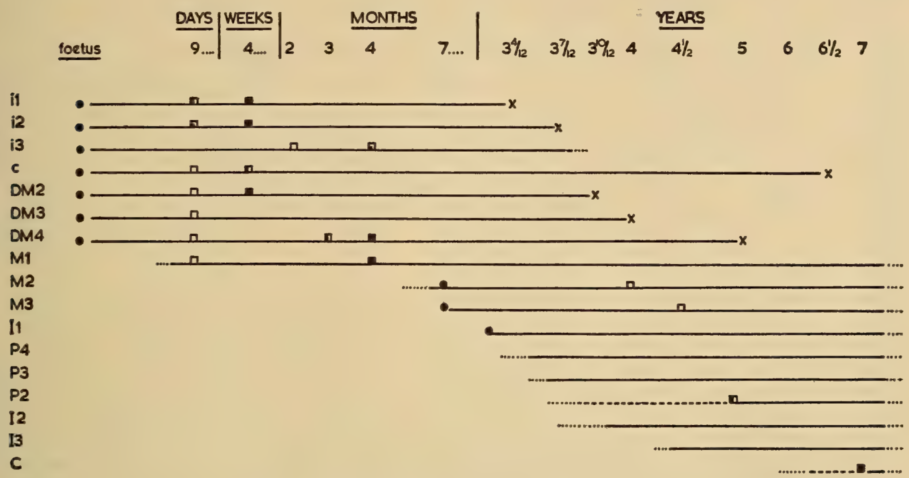

Fig. 3. Schematization of the order of eruption of teeth in *Giraffa camelopardalis* and a determination of the absolute age of tooth eruption.

● — Teeth deeply embedded in bony alveolus (Stage 0).
□ — Begins to erupt through bony alveolar margin (Stage 1).
◩ — Just penetrating through bony margin (Stage 2).
◧ — Crown projecting beyond bony margin (Stage 3).
■ — Crown entirely erupted (Stage 4).
× — Tooth fallen out.

parieto-occipital, exoccipital-supra-occipital and palatal. Three different degrees of synostosis were determined: the bones may be in contact without any trace of closure (0), the suture may be half (1) or completely (2) closed (table 3); see p. 388.

The main conclusions of these observations and of their correlation with the tooth eruption order (fig. 4) are:

1. The inter-parietal suture closes first, rather early, probably at the time of eruption of M1, and is immediately followed by the closing of the parieto-occipital suture. The examination of these sutures was possible in only 20 specimens, but in only one case (83459) the parieto-occipital suture had not started to close, although M1 was already erupting (stage 3) and the closure of the inter-parietal suture was slightly delayed (half-closed), but this may be an individual variation and does not affect the general observations.

2. The occipital suture is the next to be fused. It is always closed when P3 erupts; in fact there seems to be a definite tendency to fuse even earlier, namely, during the eruption of the molars, as seen in 34428, 80146[1], 20884, 29515 and 83605.

Specimen	*Fronto-Sagittal*	*Fronto-Parietal*	*Inter-Parietal*	*Parieto-Temporal*	*Parieto-Occipital*	*Temporo-Occipital*	*Exoccipital-Supra-Occipital*	*Palatal*
32904	0	0	0	0	0	0	0	0
53544	0	0	0	0	0	0	0	0
34428	2	2	2	2	2	0	2	0
82003	0	0	2	0	1	0	0	0
83459	0	0	1	0	0	0	0	0
80146[1]	0	0	2	0	2	0	2	0
54251	0	0	2	0	2	0	0	0
54122	0	0	2	0	2	0	0	0
81826	0	0	2	0	1	0	0	0
165052	1	0	2	0	2	0	0	0
20884	0	0	2	1	2	0	1	0
29515	?	0	2	0	2	0	2	0
83605	0	0	2	0	2	0	1	0
81825	0	0	2	0	2	0	0	0
35628	1	2	2	1	2	0	2	0
27753	1	0	2	1	2	0	2	1
69403	0	0	2	0	2	0	2	0
165051	2	0	2	0	2	0	2	0
34427	2	0	2	0	2	0	2	0
27475	2	0	2	0	2	0	2	0
83458	1	1	2	0	2	0	2	0
32905	2	2	2	0	2	0	2	0

TABLE 3. Cranial suture closure in immature giraffes. The skulls have been graded according to their dental age (see text, and fig. 4 where the same information on the degree of suture closure is correlated with the tooth eruption order).

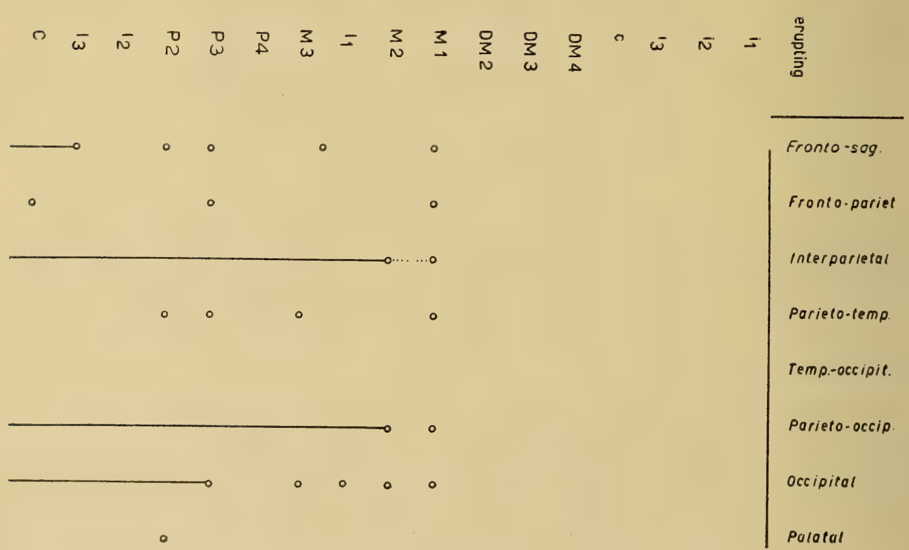

FIG. 4. The relationships between cranial suture closure and tooth eruption order in *Giraffa camelopardalis*.

O : Suture fused, at least at age of the tooth eruption stage.

—O : From the stage of eruption of this tooth onwards, all specimens found with the suture fused, i.e. in one specimen the occipital suture fused at age of eruption of M1, in another at age of eruption of M2, etc. . . .

3. The fronto-sagittal suture is always completely fused when the lateral incisor erupts, although again there is a tendency to fuse earlier (at the time of eruption of M3 or of the premolars).

4. The fronto-parietal suture fuses at the end of the sub-adult period of growth, but, as a general rule, it is not completely fused before completion of growth.

5. The temporo-occipital and the palatal sutures close much later, during adult life, although the latter has been observed partially fused in one case (27753) at the eruption of P2. It has already been mentioned that late synostosis or retardation of closure may occur as an individual variation, and similarly, an acceleration has been observed in specimen 34428, in which, at the time of eruption of M1 (stage 1), all the sutures normally fusing during juvenile or sub-adult life are already completely closed.

C. Skull growth and cranial measurements

From a few cranial measurements (table 4), it is possible to draw some conclusions about growth patterns in modern giraffes. First of all, the ratio fronto-sagittal length/basion-nasal length is practically constant, the range of variation being relatively very small (31·6–36·9) and not altering with the growth gradient. Similarly, the ratio basion-palatal length/palato-nasal length is practically constant, indicating that both elements of the skull length (cerebral and facial) grow at a rather parallel tempo.

Specimens from American Museum of Natural History	*Biorbital diameter*	*Basion-palatal*	*Palatal-nasal*	*Maxillary breadth opposite* M^1	*Frontal length*
53544	111				78
82003	178	139	162	104	111
80146[1]	175			112	
83549	180	138	210	106	117
80146[2]	189		163	124	124
53548	217	183	260	127	149
54122	203			129	139
20884	183	165	262	119	143
165052	243	183	297	140	156
81825	251	208	311	145	171
83605	235	194	304	139	171
35628	215	180	305	118	169
27753	255	200	249?	138	176
81826	209	169		133	154
165051	276	219	366	152	191
83458	268	209		142	174
69403	276	207	336	152	177
Specimens from U.S. National Museum					
163112	186	133	208	107	120
14411	162	128	191	106	117
252549	173	146	231	111	121
252585	184	142	203	111	124
299998	177	147	203	113	123
162989	226	170	268	130	143
154033	268	$\underbrace{570}$		149	211

Table 4. Cranial measurements (mm.) of immature modern giraffes. (Basion-nasion distance obtained by addition of basion-palatal and palatal-nasal measurements.)

Comparing further the growth of the fronto-sagittal length and of the biorbital breadth respectively, one sees that parallel to the increasing length of the skull, there is a very slight reduction of the biorbital breadth, and a more marked relative decrease of the maxillary breadth (fig. 5). Another expression of the same trend is that with the increasing absolute biorbital breadth, there is a decrease in the ratio maxillary/biorbital breadth. Thus during the juvenile and adolescent growth periods of giraffes, the upper portions of the skull, both facial and cerebral, develop at a quicker tempo than the lower part of the face, the breadth of which decreases relative to the biorbital breadth and the frontal length.

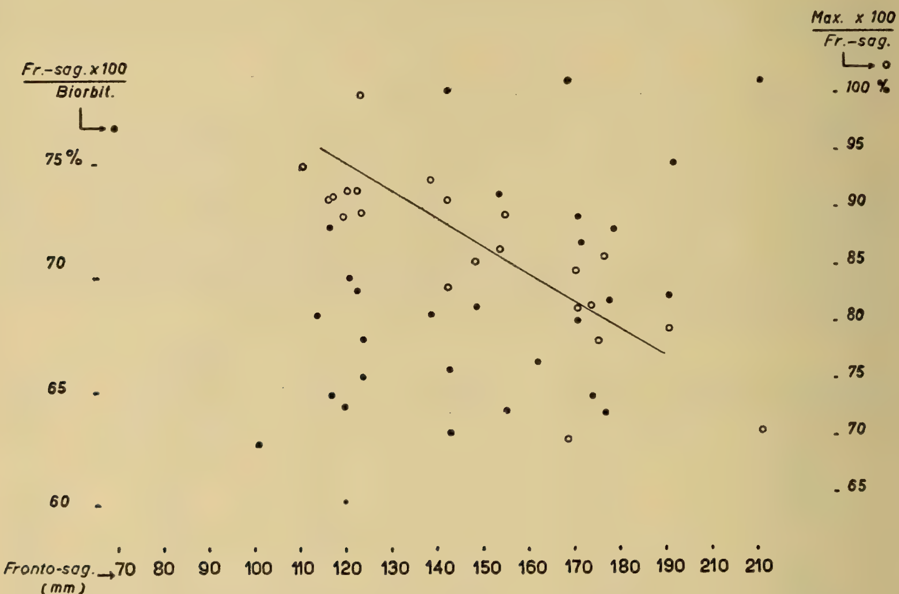

FIG. 5. Comparison of growth of the fronto-sagittal length and of the biorbital breadth.

CHAPTER 4

VARIATIONS OF THE CUSPS OF THE TOOTH CROWN

The variations of cusp-development have been studied in the dentition of the extant giraffe. A large number of teeth have been surveyed (table 5). As regards the cusp-pattern, there is very little difference between right and left corresponding teeth in the same jaw: therefore the observations summarized here will concern only one of each pair of teeth. In the following table, the numbers in brackets indicate the actual number of individual pairs of teeth, while the non-bracketed numbers indicate the actual number of teeth available.

	P2	P3	P4	M1	M2	M3
Upper	117 (59)	120 (60)	116 (58)	138 (69)	130 (65)	121 (61)
Lower	109 (55)	124 (62)	127 (64)	143 (72)	135 (68)	124 (61)

Table 5.

First, the development of the main (crown-) cusps, *cones* or *conids*, and secondly that of the secondary cusps, lateral *styles* or *stylids*, are dealt with. In each section, the molars will be described first, and then the premolars.

Main Cusps

1. Molars. The four main *cones* and the five *conids* of all the molars surveyed show no significant variability. In the upper molars, there is a rather equal development of *proto-* and *hypocone* on the lingual side, while on the buccal aspect, the *paracone* is regularly, and probably typically, more developed than the *metacone* of the same tooth. This is applicable to all true molars, although the vertical *costa* of the *paracone* seems to be more strongly built in M^2 than in M^3, and still more in M^1 than in M^2.

In the lower molars, the fused *para-metaconid* on the lingual surface of the anterior pillar is slightly more developed than the corresponding *entoconid* on the posterior pillar, but the difference does not show as markedly as in the opposing upper tooth. The *talonid* is always very well defined in M_3: its A–P occlusal length, measured in 78 cases, is 23·3% ($\pm$ ·31) of the total mesio-distal length of the tooth (range of variation: 16·5–30·8; $\sigma = 2{\cdot}70$).

2. Premolars. The premolars show the typical main cone pattern: the unilobed upper premolars have three cusps—the *protocone* is on the lingual side, and the *paracone* and *metacone* on the buccal side are fused into one single enamel crest which terminates mesio-buccally in the *parastyle.* In the lower premolars the more complicated but typical features of the giraffid tooth are always recognizable: *paraconid* and *metaconid* are fused into one single mesio-lingual ridge on P_4, but they are more isolated on the anterior premolars when the *paraconid* is much smaller, while in P_2 it is restricted to an ill-defined formation on the outer (buccal) border of the crown. The *entoconid* is always very well defined and linked with the *protoconid* on the buccal aspect by means of a strong ridge of enamel running outwards (buccally) and forwards (mesially) across the horizontal surface of the tooth The *hypoconid* on the buccal aspect is always markedly separated from the *protoconid* by a well-defined vertical furrow which, however, decreases from the grinding surface downwards and disappears before reaching the bulging of the crown well above the margin of the crown-root junction

Secondary Cusps

The observations indicate that there is little variation in the main cusp pattern of the modern giraffe teeth. In contrast, the secondary cusps show a marked degree

of individual variation, some of the most characteristic expressions of which will be described below. No emphasis will be placed on the median anterior or posterior cusps, *para-* and *metaconule* respectively, because it is almost impossible to distinguish these formations in many cases, as the demarcation between them and the *proto-* or *hypocone* is hardly noticeable along the *proto* or the *hypo-* (*meta-*) *loph.*

Vertical elevation of the cingulum to form *styles* or *stylids* on the peripheral enamel coat of the tooth is common. Various features can be observed which, for the sake of clarity, are classified here into two main types: (*a*) the *ridge*-type and (*b*) the *column*-type. Variations of both types are quite numerous.

(*a*) the thin *ridge* of enamel may appear either as a straight or a notched crest, and may even have a comb-like appearance distally detached from the crown (fig. 6).

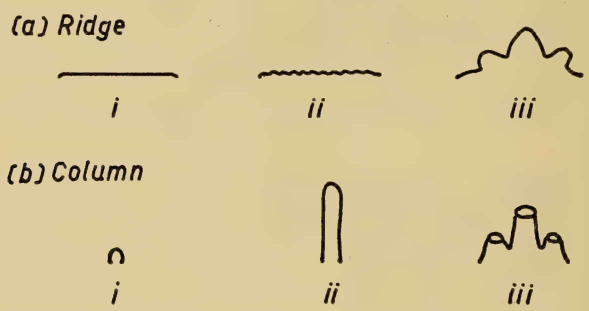

FIG. 6. Types of styles or stylids developing from the cingulum in *Giraffa camelopardalis.*

(*b*) The *column* type presents as a better defined formation rising from the cingulum or the enamel coat either as a small tubercle or a developed narrow column or pillar. In some cases this column appears to be truncated and flanked on both sides by smaller tuberosities.

The column type secondary cusps are always found on molars and premolars, anterior and posterior to the buccal *paracone* and *metacone*, and to the lingual *para-metaconid* and *entoconid* of upper and lower teeth respectively, i.e. *parastyle* and *-stylid**, *mesostyle* and *metastylid*, *metastyle* and *entostylid*. The *parastyle* and *metastyle* in the upper premolars, the *parastyle* and *mesostyle* in the upper molars, the *entostylid* in the lower premolars, and the *metastylid* and the *entostylid* in the lower molars are typically the best defined and the least variable of these lateral (buccal upper or lingual lower) secondary cusps.

On the other hand, the lingual surface of the upper teeth and the buccal and posterior surfaces of the lower teeth show a very marked variation in their *styles*

* The column-like *parastylid* however is usually rather poorly developed. In a few cases, it was even observed being replaced by a more ill-defined crest-like *stylid.* This latter feature is shown in one P_3, two P_4, two M_1, five M_2 and five M_3.

(*stylids*). Indeed, in this region, both types of cusps occur, but it should be noted that while the ridge-type has been observed on both premolars and molars, the column-type has only been observed on molars. Furthermore, while ridges may represent the *protostyle* (*-stylid*), the *entostyle* (*-stylid*), the *hypostyle*, the *ectostylid* or the *hypoconulid*, the column type secondary cusps recorded are ALL (on these surfaces) *entostyles* (*-stylids*) and *ectostylids*. Such formations on the lingual surface of the upper teeth and on the buccal and posterior surfaces of the lower teeth have been observed in 294 cases of the 754 pairs of teeth studied; in six cases, however, two *styles* were observed on the same tooth, so that the actual proportion of teeth affected by these secondary *styles* (*stylids*) is 38·2%. The following table illustrates the distribution of these *styles* among the types of teeth; the figures in italics represent the column-type *styles*, while the non-italicized ones represent the ridge-type cusps.

	P2	P3	P4	M1	M2	M3
Protostyle	1 (1·7%)	1 (1·7%)	1 (1·7%)	5 (7·2%)	5 (7·7%)	4 (6·5%)
Entostyle	7 (11·9%)	7 (11·7%)	6 (10·3%)	1 (1·4%)		
				27 (39·2%)	*25* (38·4%)	*33* (54·1%)
Hypostyle	4 (6·8%)	5 (8·3%)	5 (8·6%)			1 (1·6%)
Protostylid	2 (3·6%)	4 (6·5%)	2 (3·1%)	20 (27·8%)	18 (26·5%)	17 (27·9%)
Ectostylid		1 (1·6%)		1 (1·4%)	2 (2·9%)	2 (3·3%)
				43 (59·7%)	*20* (29·4%)	*18* (29·5%)
Hypoconulid		1 (1·6%)	1 (1·6%)	1 (1·4%)	1 (1·4%)	1 (1·6%)
Entostylid						2 (3·3%)

TABLE 6. Distribution of secondary cusps in extant giraffe teeth. (Bracketed figures indicate percentage of pairs of teeth available.)

The above figures show clearly the degree of variation of secondary cusp formation in the extant giraffe dentition. It indicates that the tendency for such additional features is much more developed in the molars than in the premolars, and it is probably more in the lower than in the upper teeth. In the upper molars the tendency increases in a posterior direction, while in the lower teeth M_1 seems to be the most affected, with an average of 0·9 of a cusp per tooth, the corresponding average for M_2 and for M_3 being 0·6. Furthermore, 7 *ectostylids* were routinely recorded because of their big size: all of them were observed on M_1. *Entostyles* and corresponding *ectostylids* are the most frequently occurring secondary cusps: they represent 36·1% and 29·6% of the total respectively.

CHAPTER 5

DIMENSIONS OF THE TEETH

A. Adult Dentition

From the maximum antero-posterior (mesio-distal) and transverse dimensions of each tooth, the ranges of variation have been established, as well as the mean and standard error (M + s.e.), the standard deviation (σ), and the coefficient of variation (V) (table 7). The data, as well as the indices, have also been expressed

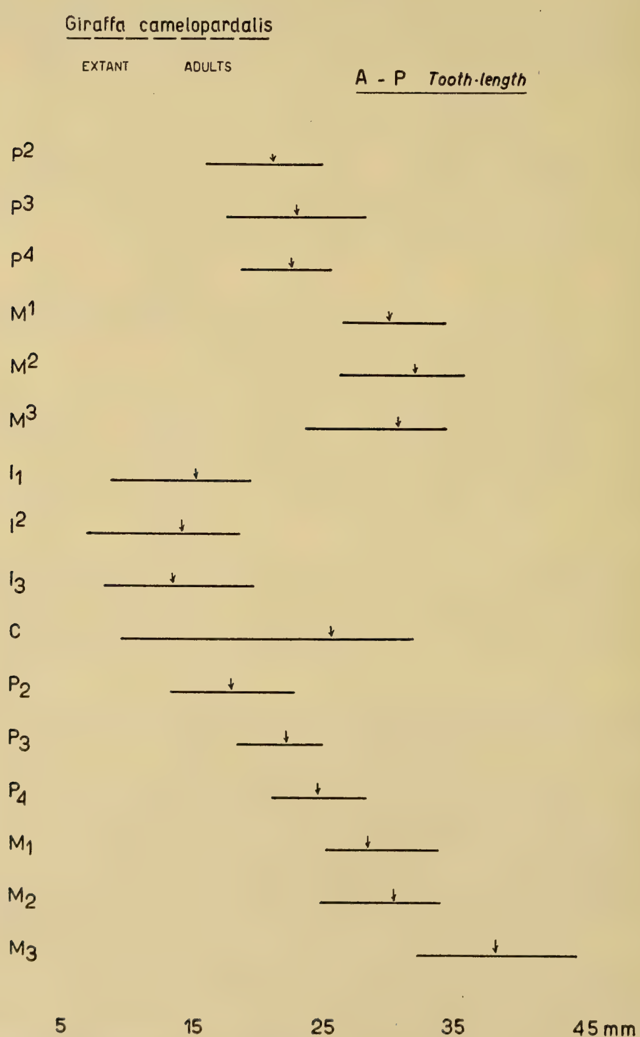

Fig. 7. The ranges of variation of the A–P length of the permanent teeth in *Giraffa camelopardalis*. $\downarrow$ = the mean value.

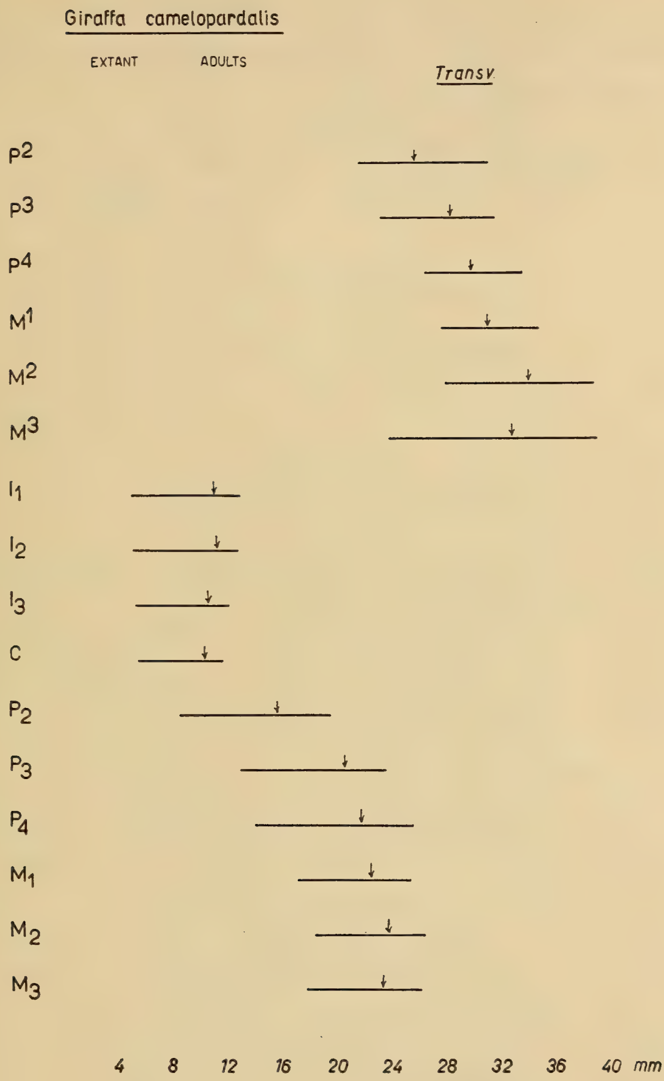

FIG. 8. The ranges of variation of the transverse diameter (breadth) of the permanent dentition.
↓ = mean value.

in graphic form (figs. 7, 8 and 9). It may be observed from the mean and from the relative dimensions of the teeth (fig. 10), that there is a decreasing gradation of size for the postcanine teeth from back to front, except for M2 which is in general longer (A–P) in the upper jaw, and broader in both jaws, than M3. The decrease in size of the teeth in both upper and lower jaw is gradual, except for P2, which is relatively

much smaller than P3 (more in the lower than in the upper). In the family Giraffidae, P1 has disappeared, while the unusual decrease in relative size observed in P2, linked with the fact that in some specimens it is also absent (see chapter 3), may suggest an eventual disappearance of P2.

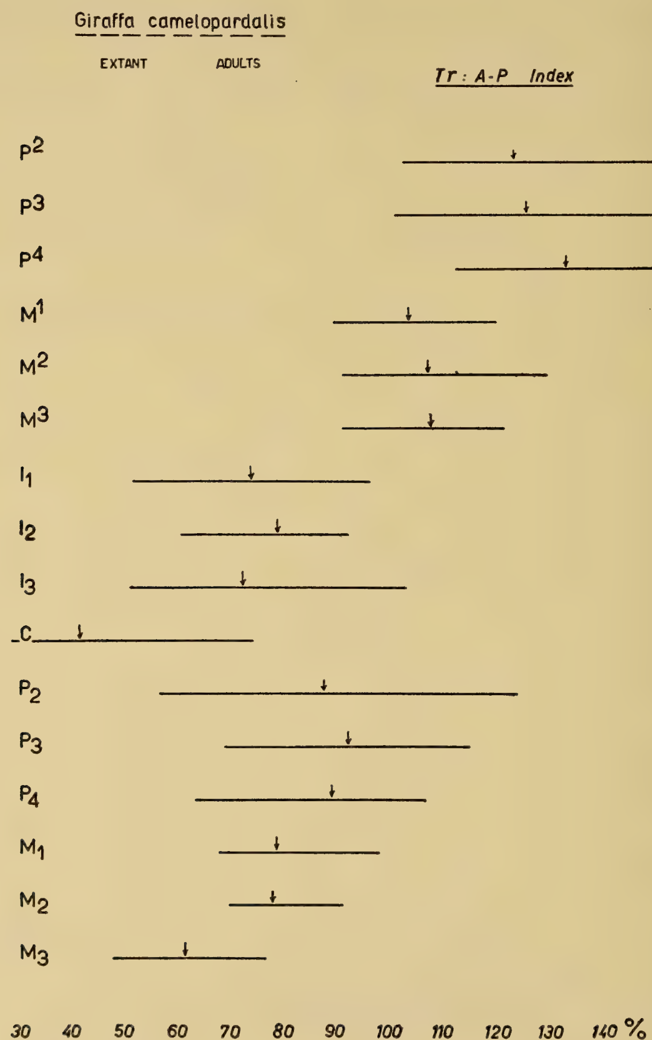

FIG. 9. The ranges of variation of the transverse/A–P index of the permanent dentition.
↓ = mean value.

Both the premolars and the molars of the upper jaw tend towards a square shape, the breadth being normally even greater than the A–P length (fig. 10). In table 7 (and fig. 9) this is indicated by the fact that the mean of the transverse/A–P

Tooth	A — P (mm.)					Transverse (mm.)					Transv./A — P Index				
	N	M + s.e.	Range of Variation	σ	V	N	M + s.e.	Range of Variation	σ	V	N	M + s.e.	Range of Variation	σ	V
I_1	50	15·00±·326	8·6—19·2	2·31	15·46	49	10·92±·202	4·9—12·8	1·42	13·00	48	73·34±1·278	52·1— 97·0	8·86	12·08
I_2	51	14·00±·301	6·8—18·3	2·15	15·35	50	11·08±·176	5·0—12·6	1·25	11·28	50	78·69±1·210	60·9— 94·0	8·56	10·87
I_3	42	13·36±·376	8·5—19·5	2·44	18·26	43	10·48±·180	5·2—12·0	1·18	11·25	46	71·91±1·460	50·7—103·0	9·90	13·77
C	49	25·39±·688	9·5—31·7	4·82	18·98	50	10·24±·181	5·4—11·5	1·28	12·50	47	41·02±1·176	28·6— 70·4	8·06	19·64
P_2	109	17·80±·203	13·3—22·6	2·12	11·92	109	15·57±·225	8·4—19·4	2·35	15·09	109	87·41±1·100	56·5—124·0	11·55	13·21
P_3	125	22·06±·149	18·4—24·8	1·65	7·47	124	20·53±·191	12·9—23·5	2·13	10·37	124	91·95± ·801	68·8—115·0	8·90	9·67
P_4	126	24·54±·144	21·0—28·1	1·62	6·60	126	21·76±·156	14·0—25·5	1·88	8·62	126	89·02± ·602	63·7—106·9	6·75	7·58
M_1	148	28·36±·145	25·1—33·7	1·78	6·27	142	22·27±·120	17·1—25·3	1·43	6·42	143	78·59± ·432	67·9— 98·1	5·15	6·55
M_2	136	30·32±·155	24·7—33·9	1·80	5·93	133	23·61±·123	18·3—26·4	1·42	6·01	135	77·77± ·355	69·7— 90·9	4·12	5·29
M_3	126	38·16±·228	32·1—44·3	2·56	6·70	120	23·30±·168	17·7—26·1	1·84	7·89	120	61·21± ·445	47·6— 76·4	4·90	8·00
P^2	126	20·78±·141	15·8—24·6	1·58	7·60	117	25·59±·181	21·5—30·7	1·96	7·65	117	122·86± ·856	104·0—149·0	9·25	7·52
P^3	128	22·60±·141	17·3—27·9	1·60	7·07	118	28·12±·160	23·1—31·4	1·73	6·15	118	125·12± ·772	101·0—156·8	8·42	6·73
P^4	123	22·24±·128	18·4—25·3	1·41	6·33	115	29·65±·147	26·3—33·1	1·58	5·32	115	132·86± ·763	114·0—158·4	8·17	6·16
M^1	141	29·71±·166	26·2—33·5	1·97	6·63	136	30·91±·166	27·5—34·6	1·93	6·24	136	103·91± ·507	88·0—119·4	5·94	5·71
M^2	137	31·72±·178	26·0—35·4	2·09	6·58	131	33·83±·167	27·8—38·5	1·91	5·64	130	106·79± ·495	91·6—128·0	5·60	5·24
M^3	126	30·41±·188	23·5—34·1	2·26	7·43	122	32·62±·207	23·7—38·9	2·28	6·98	121	107·44± ·629	91·5—122·4	6·92	6·44

TABLE 7. Dimensions of teeth of modern adult *Giraffa camelopardalis*.

index is greater than 100. On the other hand, in the lower jaw, the A–P length is always greater than the breadth, so that the teeth tend to be rectangular in their longitudinal axis.

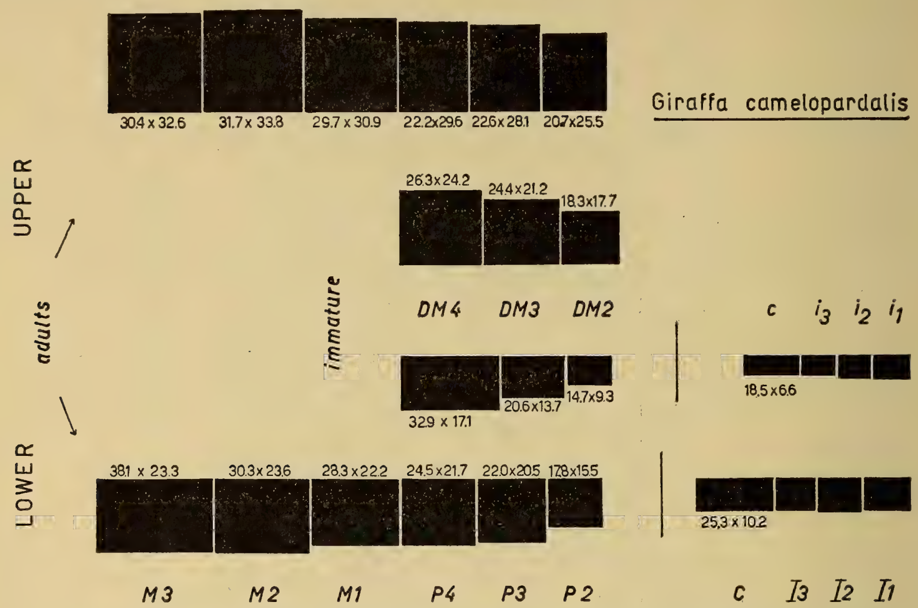

FIG. 10. Graphic representation of the relative ranges of dimensions (A–P length and breadth) of adult and milk (immature) dentitions. Mean dimensions are indicated.

Although similar in breadth to the incisors, the canine is approximately twice the length of each incisor, probably because of its bilobate nature. The incisors show a decreasing length (A–P) from front to back, although they have approximately the same breadth.

Index		N	*Range of Variation*	M	s	V
Length	$\frac{P^2}{P^3}$	122	73·8—109·2	91·94±0·527	5·86	6·37
Breadth	$\frac{P^2}{P^3}$	106	74·0—104·8	91·28±0·429	4·38	4·79
Index	$\frac{\text{Transv./A–P } P^2}{\text{Transv./A–P } P^3}$	105	84·0—131·2	99·98±0·841	8·58	8·58
Length	$\frac{P^3}{P^4}$	121	84·9—124·0	101·60±0·572	6·30	6·20
Breadth	$\frac{P^3}{P^4}$	109	79·6—105·9	95·02±0·373	3·88	4·08
Index	$\frac{\text{Transv./A–P } P^3}{\text{Transv./A–P } P^4}$	109	70·8—111·6	94·19±0·653	6·80	7·21
Length	$\frac{P_2}{P_3}$	109	56·2— 94·8	80·40±0·746	7·76	9·65

Index		N	*Range of Variation*	M	s	V
Breadth	$\frac{P_2}{P_3}$	110	57·7— 98·8	76·70±0·665	6·92	9·02
Index	$\frac{\text{Transv./A–P } P_2}{\text{Transv./A–P } P_3}$	109	74·2—130·0	95·84±1·042	10·84	11·31
Length	$\frac{P_3}{P_4}$	123	77·8—103·1	90·23±0·396	4·36	4·83
Breadth	$\frac{P_3}{P_4}$	116	68·8—105·0	93·17±0·570	6·10	6·54
Index	$\frac{\text{Transv./A–P } P_3}{\text{Transv./A–P } P_4}$	121	78·8—128·4	103·64±0·781	8·60	8·29
Length	$\frac{M^1}{M^2}$	127	80·5—101·6	93·12±0·348	3·90	4·18
Breadth	$\frac{M^1}{M^2}$	121	81·3— 98·8	91·44±0·320	3·52	3·84
Index	$\frac{\text{Transv./A–P } M^1}{\text{Transv./A–P } M^2}$	120	84·8—108·9	98·12±0·412	4·50	4·58
Length	$\frac{M^2}{M^3}$	122	84·6—140·8	104·13±0·665	7·32	7·02
Breadth	$\frac{M^2}{M^3}$	116	92·2—119·0	104·12±0·413	4·41	4·23
Index	$\frac{\text{Transv./A–P } M^2}{\text{Transv./A–P } M^3}$	114	81·7—117·9	100·15±0·618	6·56	6·55
Length	$\frac{M_1}{M_2}$	135	74·8—106·0	93·76±0·415	4·82	5·14
Breadth	$\frac{M_1}{M_2}$	134	83·9—101·8	94·38±0·276	3·18	3·36
Index	$\frac{\text{Transv./A–P } M_1}{\text{Transv./A–P } M_2}$	133	88·9—127·8	100·99±0·520	5·98	5·92
Length	$\frac{M_2}{M_3}$	125	69·8— 95·4	79·58±0·421	4·68	5·88
Breadth	$\frac{M_2}{M_3}$	120	87·1—133·4	101·34±0·372	4·06	4·00
Index	$\frac{\text{Transv./A–P } M_2}{\text{Transv./A–P } M_3}$	120	109·0—150·5	127·38±0·782	8·52	6·68
Breadth	$\frac{P^3}{M^1}$	108	73·6—106·2	91·03±0·469	4·84	5·31
Breadth	$\frac{P^4}{M^1}$	108	83·0—109·5	95·74±0·458	4·72	4·93
Length	$\frac{P_4}{M_2}$	124	69·0— 89·6	80·96±0·388	4·31	5·32
Breadth	$\frac{P_4}{M_2}$	121	76·6—104·2	92·62±0·485	5·34	5·76

TABLE 8. Dental Index for lengths and breadths, as well as the index for the transv./A–P ratios of successive permanent teeth of *G. camelopardalis*.

The ratios of the length and of the breadth of successive postcanine teeth (P2/P3, P3/P4, M1/M2, M2/M3) are expressed as the 'Dental Index' for premolars and molars. For both their lengths and breadths, the range of variation, mean, standard error, standard deviation and coefficient of variation were determined (table 8, fig. 11). In addition, the ratios of the transverse/A–P dimensions have been compared and expressed as an Index. This data has proved particularly valuable in assisting the authors to determine the diagnosis of isolated fossil teeth. In this respect, the ratios of the breadths of P^3/M^1, P^4/M^1, P_4/M_2, and of lengths of P_4/M_2 have also been helpful (table 8).

B. Deciduous Dentition

The measurements of 331 milk-teeth are summarized in table 9 and figs. 10, 12. It is clear that the front teeth (incisors and canines) and the first molar, both in the mandible and the maxilla, have the largest coefficient of variation, while the postcanine teeth show much less variation of both length and transverse breadth. In most of the cases, the breadth seems to be slightly less variable than the length.

Tooth	A–P (mm.)					Transverse (mm.)				
	N	Range of Variation	M	σ	V	N	Range of Variation	M	σ	V
i_1	23	9·5–13·5	11·53±·225	1·08	9·36	22	6·0–8·2	7·48±·127	0·60	8·02
i_2	24	7·2–13·5	11·27±·308	1·51	13·39	23	5·7–8·2	7·22±·133	0·64	8·86
i_3	27	7·7–18·8	10·85±·219	1·14	10·50	26	5·0–7·7	6·67±·149	0·76	11·39
c	30	13·8–21·4	18·54±·285	1·56	8·41	30	4·7–8·4	6·64±·135	0·74	11·14
DM_2	37	12·2–19·8	14·75±·291	1·77	12·00	37	7·2–11·7	9·35±·182	1·11	11·87
DM_3	38	18·0–24·1	20·64±·230	1·42	6·87	36	11·7–15·7	13·72±·155	0·93	6·77
DM_4	39	28·0–35·9	32·99±·227	1·42	4·30	37	15·1–18·9	17·14±·171	1·04	6·06
DM^2	36	16·0–20·4	18·37±·240	1·44	7·83	36	16·3–19·5	17·79±·193	1·16	6·44
DM^3	38	22·2–27·2	24·47±·209	1·29	5·27	38	19·3–23·1	21·23±·162	1·00	4·72
DM^4	38	24·3–29·0	26·33±·191	1·18	4·48	38	21·3–26·3	24·28±·189	1·17	4·82

Table 9. Summary of measurements of 331 milk teeth. (N = number of specimens; M = mean given with standard error; σ = standard deviation; V = coefficient of variation).

The breadth/length index has also been calculated (table 10). Here again, the front teeth and first lower molar show a very high degree of variation, reaching 17·8%. The data indicate that all the milk teeth are longer than broader, the ratio being close to 100% for the upper molars. They are all relatively longer than the corresponding permanent teeth (fig. 10), and this feature is responsible for the lower index (table 10).

FIG. 11. Ranges of variation of the Dental Index for length and breadth and of the breadth/length index of permanent teeth in *Giraffa camelopardalis*. Mean values are indicated.

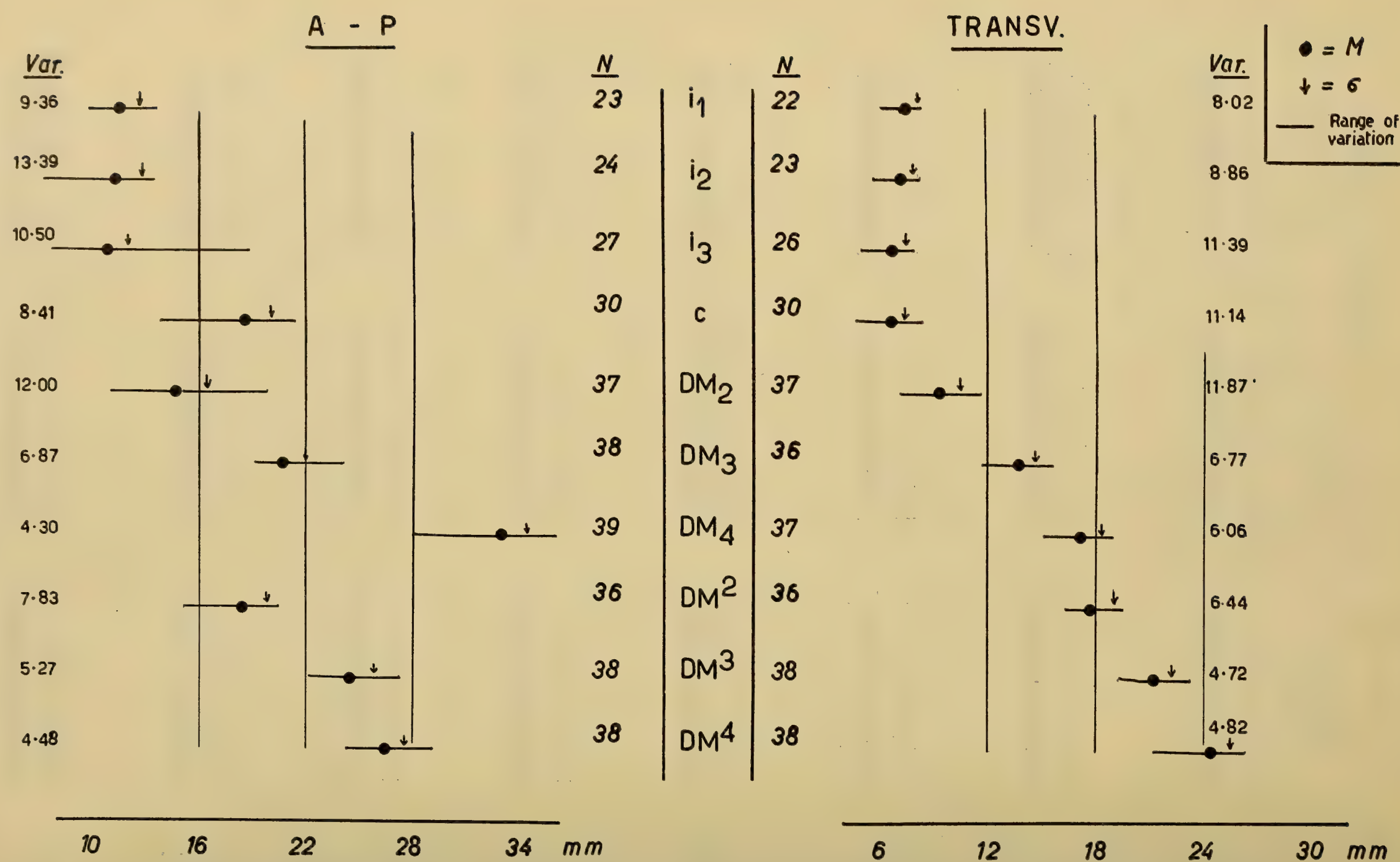

FIG. 12. Graphic representation of the ranges of variation (——), mean (●), standard deviation (↓), and coefficient of variation (*var.*) of the A–P and transverse dimensions of milk (deciduous) teeth in *Giraffa camelopardalis*.

Tooth	N	Range of Variation	M	σ	V	M in corresponding permanent tooth
i_1	22	52·2— 80·1	66·14±1·149	6·80	10·28	73·34
i_2	23	48·7— 97·0	65·26±2·187	10·48	16·05	78·69
i_3	26	41·3— 81·4	62·62±1·603	8·16	13·03	71·91
c	29	24·2— 44·8	35·78± ·680	3·66	10·22	41·02
DM_2	37	41·9— 91·2	64·44±1·894	11·52	17·87	78·59
DM_3	36	52·6— 78·2	66·58±1·086	6·52	9·79	77·77
DM_4	37	46·2— 58·0	52·30± ·509	3·10	5·92	61·21
DM^2	35	86·5—106·6	96·68±1·035	6·12	6·33	103·91
DM^3	38	78·8— 96·0	86·96± ·699	4·31	4·95	106·79
DM^4	38	82·0—101·0	92·28± ·741	4·57	4·95	107·44

TABLE 10. Breadth/Length (Transverse/A–P) Index of 331 milk teeth, compared with the same index in the corresponding permanent teeth. (N = number of specimens; M = mean, given with standard error in milk teeth; σ = standard deviation; V = coefficient of variation).

The 'Dental Index' has also been determined for the immature teeth (table 11, fig. 13).

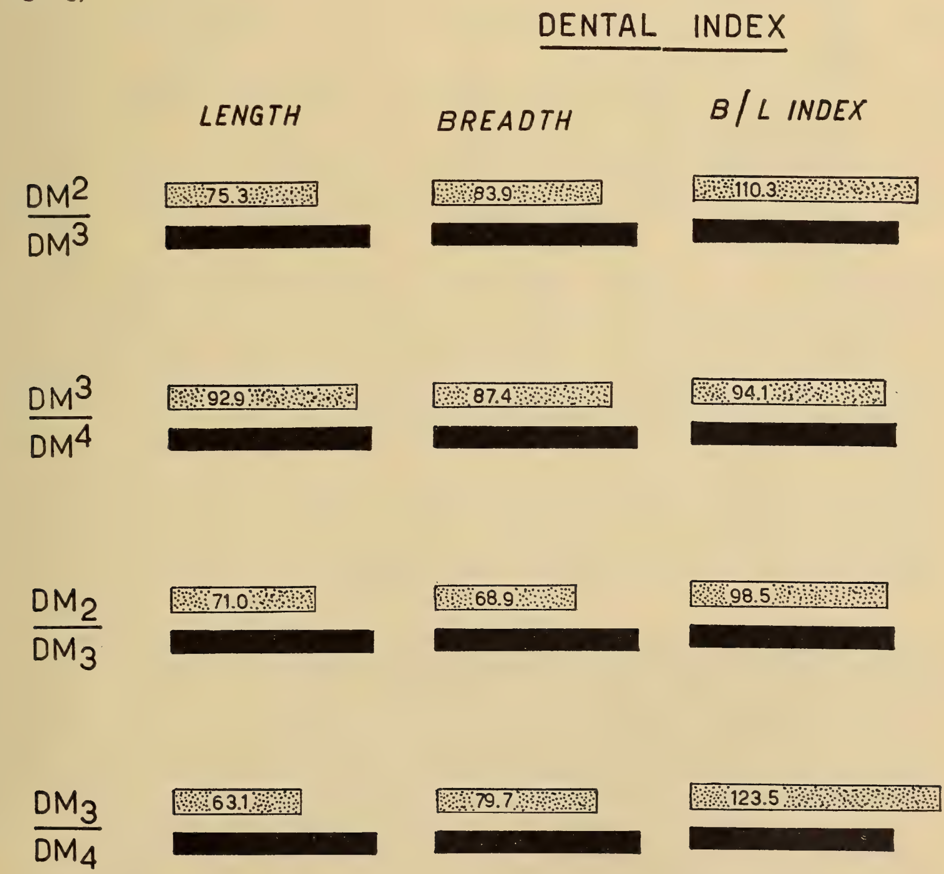

FIG. 13. Ranges of variation of the Dental Index for length and breadth and of the breadth/length index of deciduous teeth in *Giraffa camelopardalis*. Mean values are indicated.

Index		N	Range of Variation	M	s	V
Length	$\frac{DM^2}{DM^3}$	36	62·7– 81·9	75·38±0·811	4·87	6·46
Breadth	$\frac{DM^2}{DM^3}$	36	75·5– 92·3	83·94±0·678	4·07	4·84
Index	$\frac{\text{Transv./A–P } DM^2}{\text{Transv./A–P } DM^3}$	35	94·0–127·4	110·34±0·629	3·72	3·37
Length	$\frac{DM^3}{DM^4}$	38	85·7–102·2	92·93±0·545	3·36	3·61
Breadth	$\frac{DM^3}{DM^4}$	38	82·4– 92·7	87·47±0·472	2·91	3·32
Index	$\frac{\text{Transv./A–P } DM^3}{\text{Transv./A–P } DM^4}$	38	85·5–101·7	94·11±0·735	4·53	4·81
Length	$\frac{DM_2}{DM_3}$	37	54·6– 96·3	71·05±0·983	5·98	8·41
Breadth	$\frac{DM_2}{DM_3}$	35	56·2– 80·2	68·95±0·991	5·86	8·49
Index	$\frac{\text{Transv./A–P } DM_2}{\text{Transv./A–P } DM_3}$	35	63·7–134·2	98·54±3·113	18·40	18·67
Length	$\frac{DM_3}{DM_4}$	38	55·6– 72·3	63·11±0·581	3·58	5·67
Breadth	$\frac{DM_3}{DM_4}$	36	70·2– 92·1	79·73±0·821	4·93	6·18
Index	$\frac{\text{Transv./A–P } DM_3}{\text{Transv./A–P } DM_4}$	36	98·7–144·0	123·52±1·760	10·56	8·54

TABLE 11. Dental Index for lengths and breadths, as well as the index for the transverse/A–P ratios of successive immature teeth of *Giraffa camelopardalis*.

CHAPTER 6

ROOT ANOMALIES

Root anomalies are by no means uncommon among recent giraffes. They will be dealt with in the adult dentition first, and then in the milk dentition.

I. ADULT DENTITION

Three main types of anomalies have been observed: accessory roots, root reduction and root fusion.

A. ACCESSORY ROOTS

They are by far the commonest abnormality. Among the 62 adult specimens analysed, not less than 15 individuals (24%) show distinct accessory roots in a total

of 38 teeth (table 12). The data indicate that the accessory roots are found exclusively in the last two lower premolars and in the lower molars, the incidence being much higher in M_2 and M_3.

Specimen	P_3		P_4		M_1		M_2		M_3	
	R	L	R	L	R	L	R	L	R	L
X_3	x									x
X_1								x		
24291					x	x				
27137							x	x		
27752							x	x	x	x
34425									x	x
34424		x					x	x	x	x
34426	?		?				?		?	
35536							x	x	x	x
51198		x			x				x	x
69403						x		x		x
83460		x								
139696							x	x		
154033							?			
251797									x	
TOTAL	≥ 5		≥ 1		4		≥ 14		≥ 14	

TABLE 12. Distribution of accessory roots in adults. (R = right, L = left. In two specimens, it has been impossible to tell from the records whether the anomaly affects the particular teeth bilaterally or not: a '?' indicates that the side is unknown).

The most common type is that of a small, thin and short root located between the two major anterior and posterior roots, either on the buccal or the lingual side. It never develops the flattened plate shape (side-to-side) of the two main roots. It is rather circular, hardly extending into the bony socket of the mandible. In some cases it is poorly developed, resembling a very small tubercle and projecting 2 or 3 mm. from the root base, forming a small depression in the alveolar border of the mandible. In this series the accessory root is always situated on the lingual side of the premolars and on the buccal side of the molars. On the premolars it occurs unilaterally, whereas—with very few exceptions—the accessory root is bilaterally situated on the molars when present. In these cases, the right molar presents the anomaly as the mirror image of the left corresponding tooth.

It is a debatable point whether this root is really an *accessory* root or whether it is just the result of some division or splitting off of one of the main roots. On one specimen only (27137), there is a definite indication of a bilateral division of the anterior root of M_2: on both teeth the anterior root is bifid, the distal branch being clearly situated under the protoconid. In all the other cases, however, the accessory root is central, situated under the protoconid-hypoconid junction, quite separate from the anterior and posterior main roots.

It is not possible to link in any way the molar accessory root with the presence of an ectostylid: among the 21 cases of molar accessory roots, only 13 correspond to specimens presenting any form of ectostylid. This does not indicate a significant

correlation between accessory root and ectostylid, especially when one considers that in 86 molars presenting an ectostylid (table 6) there are only 13 which have an accessory root.

B. Root reduction

Root reduction has been observed in three cases only, all P_2. In these, the tooth has only one single root, round in section and rather conical in appearance, instead of the two normal (anterior and posterior) roots. The specimens are 34423, 34424 and 83460. On the former two, the reduction has only been observed unilaterally, the corresponding opposite tooth root being perfectly normal. Specimen 83460 has only one P_2 (right), the corresponding left premolar being congenitally absent. The measurement of the teeth concerned in the three specimens are compared with the mean and range of variation of 109 other P_2 specimens (table 13):

Specimen			A–P	Transverse	Transv./A–P Index
34423	R	(reduced root)	13·8	12·2	88·4
	L	(normal root)	18·9	15·9	84·0
34424	R	(normal root)	14·1	17·5	120·4
	L	(reduced root)	15·5	16·4	105·9
83460	R	(reduced root)	13·6	13·5	99·2
	L	(tooth absent)	—	—	—
Series of 109 *teeth*					
Mean			17·8	15·5	87·4
Range of variation			13·3—22·6	8·4—19·4	56·5—124·0

Table 13.

From these figures it may be inferred that, in two of the three observed cases, reduction of the root corresponds to an appreciable reduction in A–P diameter (viz. 22·5% and 23·6% in 34423 and 83460 respectively). The reductions in transverse diameter are 21·7% and 12·9% respectively: it is probably not very significant, especially in view of the negative reduction (—0·5) in 34424. Similarly, in these three specimens, the A–P measurement is situated at the lower limit of the range of variation, while the transverse breadth falls within the range of one sigma from the mean value. Comparing further the teeth with the reduced root with the opposite ones which have the normal root, there is a distinct correlation between reduction in root and in size of the crown in one case only (34423). On the other hand, it is remarkable that, with the exception of the above case, a reduction in size of the tooth does not seem to correspond to a reduction of the root.

C. Root fusion

One single case of root fusion has been noted: the M^3 in 53546 has (bilaterally) a bridge completely fusing the posterior buccal root with the lingual one along the total height of the roots.

II. Milk dentition

Root variation is frequently observed in the third lower milk molar DM_4. A total of 20 immature skulls, in which this tooth was still bilaterally *in situ* and sufficiently well preserved to allow observations, were studied. All the 40 DM_4 have three roots. The two main roots (anterior and posterior) are well developed, extending bucco-lingually, being rather flattened from side-to-side, and corresponding to the two extreme pillars of the deciduous molar, but they do not show a very high degree of variability. However, situated between them, there is constantly a third root, corresponding to the intermediate pillar. It is rather buccally located, circular in shape, and is shorter than the two main roots.

The development of this central root is quite variable. The normal appearance (so-called because it was observed in 28 out of 40 cases) is that of a cylindrical root, sufficiently long to penetrate the alveolar socket of the tooth where it is really 'rooted', although less than the other two main roots. This is the general rule for the left DM_4 (18 cases), and shows in only 10 of the cases on the right side of the mandible (table 14).

Variation	Right	Left	Total
'Normal'	10	18	28
Reduced *single* central root	1	1	2
Divided central root:			
2 normal rootlets	3		3
1 normal and 1 truncated	3		3
2 truncated	2	1	3
3 truncated	1		1
Total	20	20	40

Table 14. Variability in the central root of DM_4, and distribution in right and left teeth.

In one case, this central root was so small and reduced that it hardly indented the mandible, and could scarcely be called a real root, being not very unlike some of the accessory roots observed on the permanent molars or premolars (*vide supra*), although it was much thinner. In ten cases, however, the central root was bifid or multiple, possessing two or even three small thin rootlets parallel to each other and originating from the crown-root junction. Here again there appears to be a high degree of individual variation, and one could schematically summarize the observations by distinguishing three main types of 'multiple' central root: (i) a double central root, each of the two parallel rootlets being as long and as large as the normal single ones: (ii) in addition to the normal central root, and parallel to it, the second accessory root is much shorter and reduced, hardly reaching the bone where it is never well 'rooted'; (iii) two or even three small reduced rootlets are found, truncated and just reaching or hardly penetrating the alveolar border.

CHAPTER 7

APPEARANCE AND VARIATIONS OF THE HORN-CORES

Lydekker (1904) attempts to classify *Giraffa camelopardalis*, distributed over the vast geographical area from the Cape to the Sudan and Ethiopia, according to the colour and the blotching of the skin (see Introduction, page 375) and to the variation of the horns. He describes a gradual transition from south to north from a two-horned animal into one (so far as the males are concerned) with three horns, but he believes that this is by no means regularly progressive, for one finds in the eastern districts of the Continent a five-horned and even a six-horned 'race'. On this basis, Lydekker finds it possible to distinguish:

(*a*) seven subspecies of the Northern and Eastern giraffes which are all characterized by the development of a large frontal unpaired horn, namely, *typica* (in Nubia), *reticulata* (in Somaliland), *antiquorum* (in Kordofan), *cottoni* (in South Lago, Uganda), *rothschildi* (Baringo), *tippelskirchi* (Kilimanjaro) and *congoensis* (Congo);

(*b*) four other subspecies of the Western and Southern giraffes, whose frontal horn is rudimentary or even aborted, namely, *peralta* (Nigeria), *angolensis* (Angola), *wardi* (northern Transvaal), and *capensis* (Cape) (fig. 14).

The main paired horns are always present, but particularly well developed in *rothschildi* and still better in *wardi*. Posterior or occipital horns are very well developed in these two subspecies, but less in *cottoni*. No reliable information on these posterior formations was available for *tippelskirchi* and *angolensis*. An unusual 'azygous' orbital horn was described in *cottoni* and *rothschildi*, projecting horizontally outwards from the middle of the frontal border of the right and left orbit respectively. Lydekker's observations are summarized in the following table.

Subspecies	Anterior horns	Main pair of horns	Posterior horns	Additional or 'azygous'
typica	x	x	—	—
antiquorum	x	x	—	—
reticulata	x	x	?	—
cottoni	x	x smaller than in *rothschildi*	x smaller than in *rothschildi*	x on right orbit
rothschildi	x	x well developed	x well developed	sometimes; then on left orbit
tippelskirchi	x smaller than in *rothschildi*	x	?	—
congoensis	x	x	?	—
angolensis	x	x	?	—
wardi	x large, aborted	x well developed	x stronger than in *rothschildi*	—
capensis	x rudimentary	x	—	—
peralta	—	x	?	—

TABLE 15. Schematization of Lydekker's subspecific classification and horn distribution. (x = present; — = absent; ? = doubtful.)

FIG. 14. Map of Africa indicating the distribution of the subspecies of *Giraffa camelopardalis*, according to Lydekker's classification (1904).

Because of the large amount of material available to the authors, the following observations indicate that Lydekker's useful information must be somewhat revised.

The sexual difference is very marked in the horns which are usually poorly developed in females (fig. 15): thus it is hardly possible to make any subspecific classification on the basis of the horns. The median frontal horn does not exist in females, there being only a slight swelling on the frontal without development of the 'ossicone'. The main horns, which are always much smaller than in the males of the same catalogued subspecies, measure 8–15 cm. in length from tip to base, the diameter not exceeding 3 cm. They are cylindrical and smooth, pointed at their tip, and

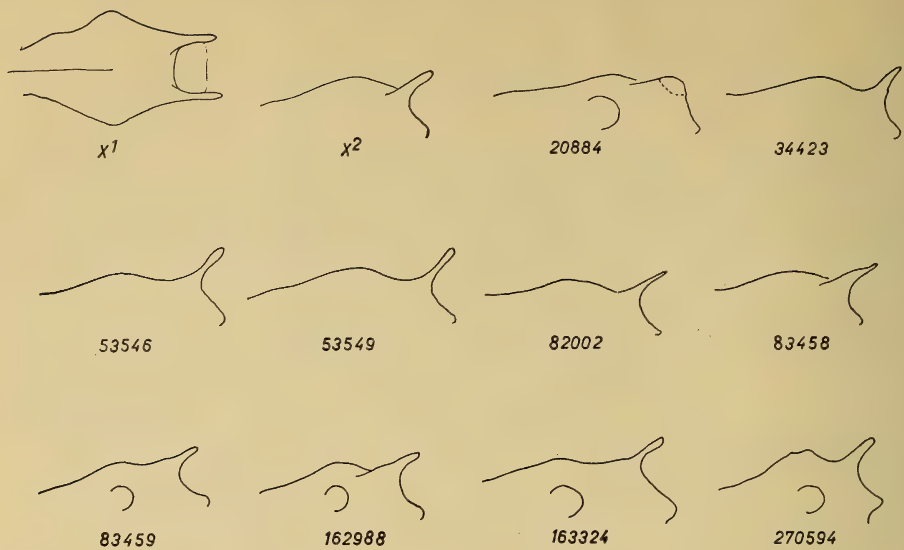

FIG. 15. Sketches showing portions of the skulls of female giraffes (*Giraffa camelopardalis*) indicating the major variations in the development of the horns. Lateral views, except X^1 which is *norma verticalis*.

usually constricted at their base. Posterior occipital horns and azygous horns were not found in the females.

FIG. 16*a*. Sketches of portions of skulls of adult male giraffes (*Giraffa camelopardalis*) showing major variations in the development of the horns. Views are either *norma lateralis* or *verticalis*.

Males show a better development of their horns (fig. 16*a*, *b*) and it is possible to notice important differences. But does the wide range of variation permit subspecific distinctions? In order to answer this question, each type of horn will be discussed separately.

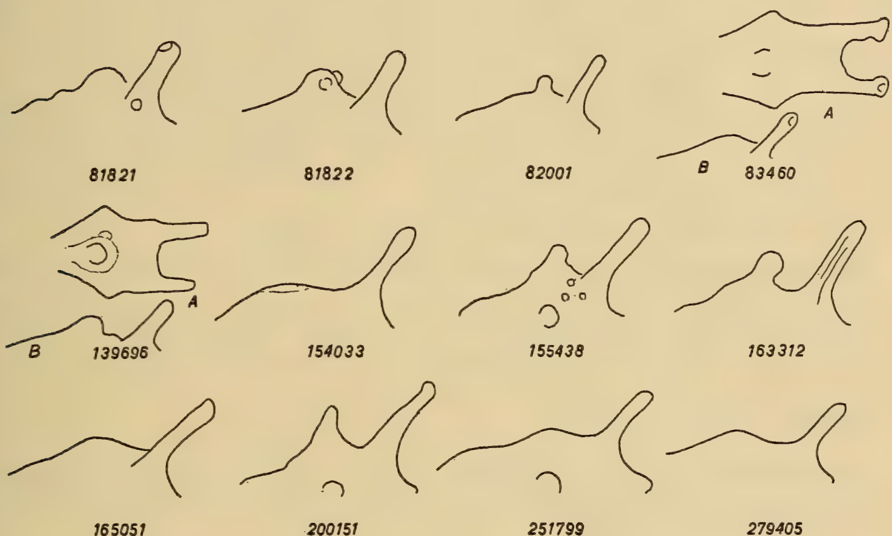

Fig. 16*b*. Further sketches of portions of skulls of adult male giraffes (*Giraffa camelopardalis*) showing major variations in the development of the horns. Views are either *norma lateralis* or *verticalis*.

A. Single median frontal horn

It varies from a simple swelling of the frontal (251799) to a true, very strongly developed horn (155438). The intermediate stages are observed as either a horny plate (154033), a slight eminence (279405), a globular formation (54123), or a rather large and regular cone (200151). Usually the anterior part of the horn has a more gentle slope (155438) which gradually extends on to the nasal bones. Very often on the median sagittal line, anteriorly, are one (155438), two (81821), three (27752), four (81820) or more (27137) smaller nodules; one or two may even be found on the side of the horn (139696) or on the top (81822 and 53765). The profile of the posterior part of the horn is mostly S-shaped (163312), so emphasizing its knob-like appearance. The whole formation is generally symmetrical on both sides of the sagittal plane. In one case however (27137), its transverse horizontal section looked like a crescent open anteriorly and to the right, with both extremities of the crescent converging towards a completely isolated smaller knob.

B. Pair of main horns

All the male giraffes have these two horns very well developed. The shape is commonly that of a rounded column, measuring 15–23 cm. in length, 4–6 cm. in breadth, and the diameter at the tip is 4–7 cm. A difference in size between right and left horn is by no means rare, the one being sometimes 35% longer than the other. Both horns are usually parallel: if not, their divergence from the base is hardly noticeable, so that the external interhorn breadth measured at their tips is always smaller than the external biorbital breadth. The angle formed by the horns with the Frankfort plane is very constant and in all the specimens where this could be measured, it ranged from 48° to 58°. The general shape of the horns is that of a column regularly cylindrical from the base upwards, and at the tip it forms a rounded knob (83460 and 24292). The tip is sometimes flattened (27137), the medial edge of which then projects more than the lateral one. In other cases the column maintains its regular circumference from base to tip (53550, 139696).

These fronto-parietal main horns are usually relatively smooth, having small, shallow vertical grooves, but they may possess a few marked axial ridges (163312 and 8371b), or display small knobs, in series of 2–5, forming irregular crests on the anterior (57675), medial (27752) or lateral (54123) margin of the horn.

C. Posterior occipital horns

The posterior 'horns' are much more a type of occipital crest or exostosis, condensed in two parallel eminences, than real horns. The crest is also very variable and may be completely absent.

D. Supplementary knobs

Smaller isolated supplementary knobs are not infrequently developed either on the lateral aspect of the frontal, between the posterior supra-orbital border and the base of the main horns (155438) when there are two or three concentrated in the same area, or on the orbital border itself (54123) when it is comparable to the azygous orbital horn described by Lydekker. But in the specimens studied it was distinctly *bilateral* and it is a *knob* rather than a 'horn projecting outwards horizontally'.

On the basis of the above results, the conclusions of Lydekker relative to the taxonomical significance of horn-shape and disposition are questionable. It is not impossible to find typical examples displaying the subspecific characteristics proposed by Lydekker: male 165051, for instance, from South West Africa, with big main horns (23 cm. in length) and a very rudimentary ossicone on the frontal. On the other hand, it is not difficult to find specimens which do not fit in his descriptions, e.g. 251799, registered as *G.c. tippelskirchi*, which certainly originated from Tanganyika, has no anterior horns and shows just a slight swelling of the frontal. Similarly specimens 24292, 34422, 34425, 34426 and 83460 which are all males from Bechuanaland (Mababe Flats) definitely have a very well developed anterior horn even though they geographically belong to the group of Angola, northern Transvaal or Cape, which—according to Lydekker's description—should have no such a large

horn. Specimens from British East Africa, identified on the basis of their skin as *G.c. rothschildi*, have very strong main horns (155438 and 200151) whose length, general pattern or morphological appearance could not differentiate them from *tippelskirchi*. Among both groups one finds long, regularly cylindrical and smooth horns, or shorter, plumper horns with knobs (163312 and 27752; 54123 and 251799). Lateral 'azygous' knobs are found in both types (27752, 54123 and 155438), but on the one skull from Uganda, which should be *G.c. cottoni*, no such knobs were found, as should have been expected from Lydekker's description.

Consequently, it would be reasonable not to attempt any subspecific determination of modern African giraffes on the basis of the horn-cores. This principle is extremely important, as will especially be indicated in the discussion on the horn-cores of the extinct giraffids.

SECTION II

THE FOSSILIZED GIRAFFIDS

Introduction

Fossilized giraffid material has been discovered at various sites in Africa, namely:

North Africa	Oran (St. Charles) (Pomel 1892);
	Bou Hanifia, Chaâchas (Reygasse, 1919–20);
	St. Arnaud (Arambourg, 1934, 1948);
	Garet (Garaet) Ichkeul (Arambourg, 1949);
	Douaria (Roman and Solignac, 1934);
	Djebel M'dilla (Arambourg, 1952).
Egypt	Wadi Natrun, Garet-el-Mulùk (Stromer, 1907);
Sudan	Abu Hugar (Bate, 1951).
East Africa	Omo (Arambourg, 1947);
	Serengeti (Dietrich, 1937, 1942);
	Olduvai and Kagua (Hopwood, 1934, 1936);
	Olorgesailie, Kanam and Rawi (Leakey, 1951).
South Africa	Vaal River (Haughton, 1922);
	Florisbad (Dreyer and Lyle, 1931);
	Cornelia and Tierfontein, near Port Allan (van Hoepen, 1932);
	Makapansgat (Cooke and Wells, 1947; Broom, 1948);
	Hopefield (Singer, 1954);
	some unknown place, probably from the Vaal River gravels (Cooke, 1949).

Nearly all the above-mentioned material have been either assembled in Cape Town on loan for study, or examined in the respective Museums where the specimens are housed. In addition, for comparative purposes, an extensive survey of the giraffid material from the Siwaliks was carried out in the American Museum of Natural History (New York) and the British Museum (Natural History), London. It was not possible to obtain the original specimens previously described from the following sites outside Africa:

Greece	Velès (Schlosser, 1921);
	Pikermi (Gaudry, 1861, 1867);
	Samos, Salonique (i.e. Bounardja and Vatelük) (Arambourg and Piveteau, 1929).
U.S.S.R.	Taraklia (Khomenko, 1913).
Hungary	Baltavar (Pethö, 1885);
	Polgárdi (Kormos, 1911).
France	Mont Lébéron (Vaucluse) (Gaudry, 1873).
Turkey	Adrianople (Abel, 1904);
	Maragha (de Mecquenem, 1924).

In respect of the latter group of specimens all the available literature was studied. All the original material (from Africa) examined will be described according to geographic distribution.

CHAPTER I

OLDUVAI (OLDOWAY) GORGE, TANGANYIKA

A. Geology

The history and the geology of the enormous Olduvai Gorge (fig. 17(*a*), (*b*)) have been recorded by Leakey and by Reck, respectively (Leakey, 1951). Five beds are described: Bed I was deposited at the beginning of the East African Middle Pleistocene (early Kamasian), Beds II and IV correspond to the Kamasian and Kanjeran pluvials respectively, the Beds III and V represent the dry inter-pluvial and the post-Gamblian periods respectively. Giraffid remains have been recovered from Beds I–IV, although most of the material comes from Bed II (*vide infra*).

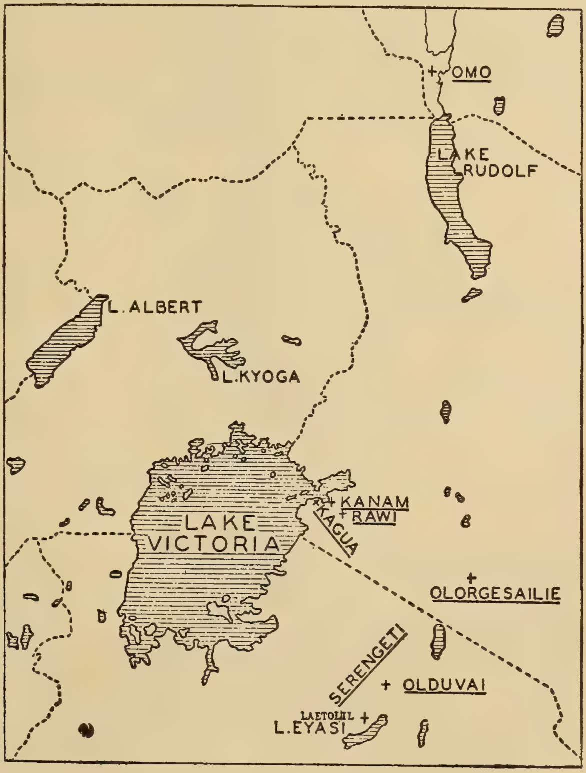

FIG. 17*a*. Map of Central-East Africa indicating some of the more important fossil sites.

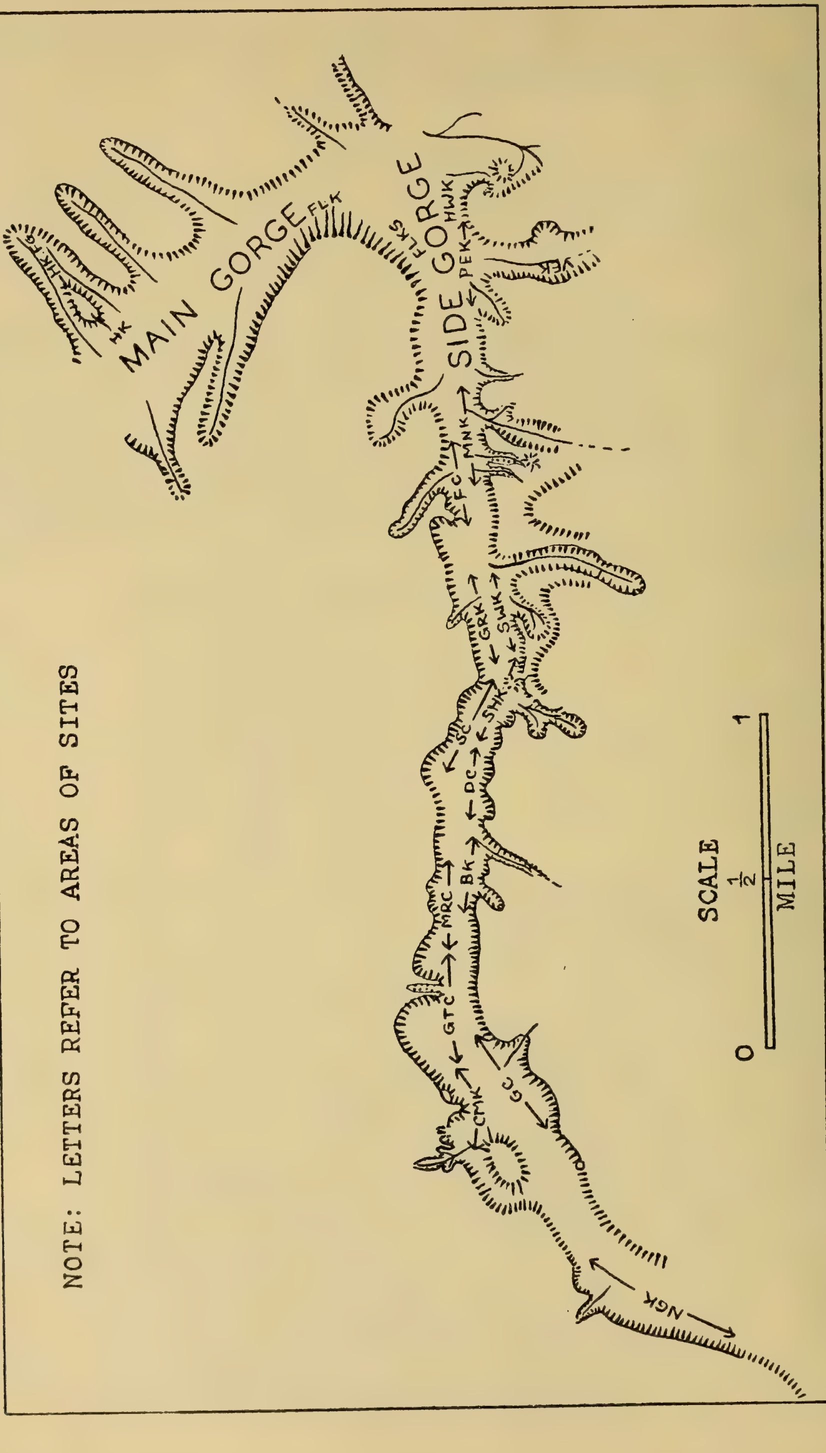

FIG. 17*b*. Map of Olduvai Gorge indicating designations of various sites (from Leakey, 1951).

B. The Material

The material recovered consists of loose teeth, or fairly complete dentitions, postcranial bones (mainly incomplete) and so-called 'antlers' (horn-cores).

1. *Previously described.* Hopwood (1934) described a right fourth lower premolar (M 14200) as the holotype of *Helladotherium olduvaiensis* sp. n., and as paratypes he mentioned a rolled fragment of a right mandibular ramus with P_4–M_1 (M 14686, horizon unknown) and a partial hind-limb (M 14687, Bed I). With the discovery of *Sivatherium*-like 'palmated antlers' (inverted commas, ours) from Bed II Olduvai (M 14954–14955) and from Kagua (M 14956), Hopwood (1936) referred the above material to *Sivatherium olduvaiense.* However, Dietrich (1937) stated that on the basis of a metacarpal (E. 122) which he had studied, he had already referred the Olduvai material to the Sivatheriinae (although he does not state whether this was ever published).

2. *Observations on material housed in the Coryndon Museum (Nairobi).* Material was kindly sent on loan by Dr. L. S. B. Leakey, Curator of the Coryndon Museum, and in addition horn-cores and postcranial remains from Olduvai were also studied in the British Museum (Natural History) and in the Coryndon Museum (Nairobi). Each specimen is described in detail, the specimen being numbered according to the museum registers, and the information given below with each number is found written on each specimen. The inscriptions have the following interpretation:

Old.	Olduvai Gorge.
Oldy.	Olduvai (Oldoway) Gorge.
BK	Indication of the site (see fig. 17(*b*)).
II	Bed II.
1951, 1952, etc. ..	Collected during those seasons.
S	The specimen has been found on the surface of the Bed referred to, but it does not necessarily belong to that Bed.
M	Before a number indicates registration by British Museum (Nat. Hist.).
Marsabit Road ..	A site about 100 miles east of the southern point of Lake Rudolph in Kenya.

Coryndon Museum Giraffid Material

A. *Horn-cores*

86	Old. BK II 1952.
Old. 1.53 ..	(Provisional number given by Mrs. Coryndon, in 1956.)
Old. 2.53 ..	(*Idem.*)
Old. 1952 ..	SHK II BK II base (S).
M 14954*b* ..	Oldy. BK II S (13.V.35).
Old. 3.53 ..	(Provisional number given by Mrs. Coryndon in 1956.)
M 17027 ..	Oldy. BK II S (14.V.35).
M 17028 ..	Oldy. BK II S (14.V.35).
M 17029 ..	Oldy. BK II S (14.V.35).
M 14955 ..	(At present in British Museum (Nat. Hist.).)

B. *Fragments of jaws*

Upper:

F 3655 ..	Right maxilla, M^1—M^3, Old. II, 1941, *in situ.*

Lower:

6	Right mandible, P_2-M_3, Old. BK II.
F 3656 ..	Left mandible, M_1-M_3, Old. II.
1	Right mandible, P_4-M_3, Old. BK II.
365	Right mandible, M_1-P_3, Old. SKH II, 1953.
392	Right mandible, M_2, Old. SHK II, 1953.
3	Right mandible, M_3, Old. BK II.
93	Left mandible, M_1-M_3, Old. BK II, 1952.
92	Left mandible, M_2-M_3, Old. BK II, 1952.
91	Left mandible, M_1-M_2, Old. BK II, 1952.
Nguntiri site .	Left mandible, M_1-M_3, Old. BK II East 1953.
321	Left mandible, M_2-M_3, Old. BK II, 1953.

C. *Isolated teeth*

Upper:

premolars..	F 2989	?P^3, Oldoway 1941 II, *in*
molars ..	F 2993	M^2, Old. II.
	4	M^3, Old. BK II.
	109	M^3, Old. BK II, 1955
	F 2992	?, Old. II *in situ.*

Lower:

canine ..	97	Old. BK II, 1952.
premolars..	F 2991	P_4, Old. I S, 1941.
	2	P_4, Old. BK II.
	5	P_4, Old. BK II.
	7	P_4, Old. BK II.
	96	P_4, Old. BK II, 1952.
molars ..	105	M_1, Old. BK II, 1953.
	132	M_1, Old. BK II, 1953.
	95	M_2, Old. BK II, 1952.
	120	M_3, Old. BK II, 1955
	—	M_3, Marsabit Road.

Fragments of molars, further unidentifiable

166	Old. BK II, 1955.
116	Old. BK II, 1953.
8	Old.
100	Old. BK II, 1953.
98–99	Old. BK II, 1952.
—	Marsabit Road.
—	Olduvai surface.

D. *Post-cranial skeletal remains*

Forelimb:

116*p*.. ..	Proximal end of ulna.	Old. BK II, 1952.
115	Distal end of radius.	Old. BK II, 1952.
341	Os magnum.	Old. BK II, 1952.
114	Distal end of metacarpal.	Old. BK II, 1952.

Hindlimb:

100	Distal end of femur.	Old. BK II, 1952.
101, 112 ..	Distal end of tibia.	Old. BK II, 1952.
103, 108 ..	Calcaneum.	Old. BK II, 1952.
102, 107 ..	Astragalus.	Old. BK II, 1952.
104, 109, 110	Cubonaviculare.	Old. BK II, 1952.
105, 110A ..	Cuneiform.	Old. BK II, 1952.
106, 111 ..	Proximal end of metatarsal.	Old. BK II, 1952.
314	Distal end of metatarsal.	Old. BK II, 1953.
M 14687 ..	Almost complete articulated hindlimb, in B.M.(N.H.).	

Proximal phalanges:

113 ..	Old. BK II, 1952.
185 ..	Old. BK II, 1953.

F 3297 .. Old. S II.
F 364 .. Old. S I, 1941.
F 365 ..
— .. .. Old. surface.

Sesamoid bone:
342 .. Old. II, 1952.

Description of Specimens

A. Horn-cores

86. *Old. BK II* 1952 (plate 1(*b*), (*f*)).

This is a right horn-core. The base is hollow, extending about 170 mm. in depth from the broken edge. In section it is roughly triangular, the rounded apex being posterior. This posterior border becomes increasingly rounded towards the tip, while the more anterior region, rounded at the base, narrows to a well-defined border towards the apex. The anterior surface has knobs on it.

The medial surface is convex, both transversely and medio-distally, and presents deep grooves. Three of these are parallel to each other and to the convex anterior border, along which they run, even on to the knobs, following their profiles. Two other grooves are some distance from the anterior border, passing parallel to each other upwards and towards the posterior border.

There is also a short, very broad, oblique groove which leaves the base at the anterior convex border and runs obliquely upwards and backwards on the medial aspect.

The general curvature and the rotation (twist or torsion) of the horn-core are not marked: it is almost straight.

No flange* is visible. This portion has been reconstructed in plaster but it would appear unlikely that a flange would have been present. The first visible knob has been called knob 2.

This specimen is very similar to the horn-core from Garet Ichkeul (see Section III, chapter 1).

Length along posterior (concave) border: 710
Length along anterior (convex) border: 810
Height of the knobs: 20-40

	Circumference	*A–P*	*Breadth**
At base	415	150	114
Just under knob 2	350	128	
At knob 2		145	89
Just under knob 3	330	119	
At knob 3		130	83
Just under knob 4	300	113	
At knob 4		135	78
Just under knob 5	280	106	
At knob 5		110	64
At 'tip' (broken)		75	63

(* Side-to-side diameter.)

Table 16. Measurements of Old. 86 (mm.).

* The term 'flange' is applied to the appearance often presented by the anterior border just above the base when it narrows, flattens and sweeps (flanges) outwards.

Old. 1.53 and **2.53** (plate 1(*c*), (*e*); 1 (*a*), (*d*)).

1.53 is a right horn-core and 2.53 a left. They are very similar to one another, although they may not belong to the same individual because the rotation (torsion) of the horns differ from each other, 1.53 rotating 90° anti-clockwise, while 2.53 rotates clockwise (normal) through 140° from base to tip. This indicates the tremendous variation in torsion between horns which are otherwise very similar. Both horns have a marked flange (267 mm. and 155 mm. in length respectively) which terminates superiorly in knob 2 above which there are three other knobs (3–5) along the antero-medial border. The flange of 2.53 is shorter than that of 1.53. On the flange of 1.53 there are four small knobs, the highest of which corresponds to knob 2. These are not present on the flange of 2.53. On both horns there is a knob opposite the middle of the flange, but it is situated on the posterior border somewhat medially. This knob is designated 'P' and may be compared with the blade-like projection which led Falconer (1868) and Abel (1904) to term the horn a tri-radiate antler.

In both specimens the anterior border first passes upwards and laterally from the base (where it is ill-defined) and at about the middle of the flange it swings towards the medial side. In this way the lower part of the horn develops its rotary twist, which is more obvious in 2.53. Thus the anterior border which at the base is really antero-lateral tends to twist to the antero-superior aspect of the horn, while the posterior border—which is postero-medial at the base—tends to become inferior at the tip. Furthermore, as a consequence of this torsion, the antero-medial surface (which has the marked grooves) comes to lie on the posterior aspect of the horn above the flange region.

In specimen 1.53 the postero-lateral surface has no grooves at all, while the antero-medial surface presents two grooves near the anterior border, both parallel to it, and both broad but not deep. The cranial fragment at the base of 1.53 contains a few shallow sinuses but does not display any sutures and it is not possible to assess the correct orientation of the horn to the skull. It would have been valuable to obtain an understanding of the position of the horn on the skull so as to determine whether the criteria the authors have utilized for 'siding' the horns are correct or not (see also Section III, chapter 1).*

The base of 2.53 is hollowed out to a depth of approximately 300 mm. from the broken edge. There are some sinuses present. The grooves resemble those of 1.53 but they are more numerous, there being four on this specimen.

Distances between the knobs	*1·53*	*2·53*
2—3	141	196
3—4	110	164
4—5	146	146

* At the galley-proof stage, Dr. L. S. B. Leakey reported to one of the authors (R. S). that a Sivatherine skull complete with attached horn-cores had just been discovered at Olduvai and that a note on it would soon be published by him.

Length of the flange	267	155
Length along anterior (convex) border	950	1010
Length along posterior (concave) border	840*	690

* A portion of skull attached to the horn is included in this measurement.

	Circumference		*A—P*		*Breadth**	
	1·53	*2·53*	*1·53*	*2·53*	*1·53*	*2·53*
At base	400	390	159	145	127	90
Middle of flange	410	420	154	172	79	81
At knob 2	380	410	145	165	84	89
Just under knob 3	300	290	105	101		
At knob 3	330	290	129	104	76	75
Just under knob 4	280	250	106	90		
At knob 4	290	260	113	97	67	63
Just under knob 5	270	250	99	97		
At knob 5	290	290	117	115	59	58
Tip	170	170	52	59	52	47

(* Side-to-side.)

TABLE 17. Measurements of 1·53 and 2·53 (mm.).

Old. 3.53 (plate 2)

This is a fragment of a left horn-core with part of the proximal portion missing. The tip and distal end are practically intact. At the base the flange is still present, ending in knob 2. Above this is a large knob 3, the only other knob on the anterior border.

The hollowed-out portion of the base is very narrow and extends about 130 mm. from the broken edge. On the antero-medial surface there are two deep grooves parallel to the profile of the knobs. There are also two more regular parallel grooves near the posterior concave border. They all extend to the tip. In addition, there are a number of small grooves at the proximal end which peter out in the region of the upper end of the flange. On the lateral surface there are some broad, but less marked, grooves. As in most of the other specimens (except that from Tierfontein) the edges of the grooves are irregular and heaped-up in parts.

The fragment, in general, is very similar to the corresponding portion of the Tierfontein horn-core (C 431). The curvature and rotation are rather poorly expressed. The region above knob 3 is almost straight.

Length along anterior (convex) border	700+
Length along posterior (concave) border	430+

	Circumference	*A—P*	*Breadth**
At base	360	138	—
Middle of flange	360	146	77
At knob 2	380	155	73
Just under knob 3	310	122	70
At knob 3	360	141	68
100 mm. above knob 3	250	89	67
At tip	150	52	43

(*Side-to-side.)

TABLE 18. Measurements of 3·53 (mm.).

Old. 1952 *SHK II BK II base* (*S*) and **M 14954b** *Oldy. BK II S.* (Plate 3(*c*), (*d*))

These are two closely fitting fragments belonging to the same left horn-core. M 14954b noted by Hopwood (1936), but he did not include the 'b'.

The flange exhibits a small knob 1 at its centre along the anterior border. Beyond knob 2 (at the upper end of the flange) are knobs 3, 4, 5 and 6.

Distances between the knobs (*mm.*)

1	— 2:	83
2	— 3:	143
3	— 4:	140
4	— 5:	111
5	— 6:	82
6	— tip:	174

There are a number of nutrient foramina (as in 1.53 and 2.53) which are not very large (2–3 mm. in diameter) and not specifically related to the grooves.

It exhibits the same type of curvature and torsion as 1.53 and 2.53 but they are much more twisted and curved. In turn, it shows more torsion than Old. 86 and 3.53. Thus it occupies an intermediate position and this series indicates a further grade of variation of the torsion of the Sivatherine horns.

As in 1.53 and 2.53, there is a medio-posterior knob ('P') on the inferior portion near the base and opposite the flange.

The grooves on the antero-medial surface are large, similar to those in the Hopefield specimens.

The base contains a few sinuses and is hollowed out to a depth of 80 mm.

The horn closely resembles M 14955 (*vide infra*).

Length along anterior (convex) border	840
Length along posterior (concave) border	580

	Circumference	*A—P*	*Breadth**
At base	330	117	100
Flange (knob 2)	350	143	78
At knob 3	360	141	66
Just under knob 4	270	102	—
At knob 4	290	112	62
Just under knob 5	240	90	—
At knob 5	260	94	64
Just under knob 6	220	80	—
At knob 6	240	85	59
Tip	150	49	46

(*Side-to-side.)

TABLE 19. Measurements of M 14954 (mm.).

M 17027 *Oldy. BK II S.*

The tip and distal portion of a right horn-core. The only interesting features are that the extreme tip is somewhat recurved posteriorly and that the grooves on the antero-medial surface have extended to the base of this recurved portion where they end abruptly. The extreme tip is rather rough and irregularly rounded.

Measurements of M 17027 (*mm.*)

Length of fragment	164		
	Circumference	*A—P*	*Breadth**
Broken end	180	63	59
Tip	—	36	36

(* Side-to-side.)

M 17028

A fragment of bone. It is difficult to be certain whether it is of a horn-core or not. The inner, smooth surface may represent a portion of the endocranial occipital region.

M. 17029 *Oldy. BK II S.*

This is the anterior border of the flange with two knobs. There is also a smaller knob (P) opposite the flange. A fairly deep groove is visible near the knobs.

Measurements of M 17029 (*mm.*)

Distance between knobs 1–2	95
Total length of fragment	228
Breadth of flange (side-to-side)	51

M. 14955 (housed in the British Museum (Natural History) (plate 3(*a*), (*b*))

This is a left horn-core, the knobs pointing antero-laterally and the grooves being on the antero-medial surface. Part of the base is broken away, so that the central (hollowed) part formed by the cranial sinuses is not distinguishable. The posterior portion of the base is rounded, while the anterior flange portion narrows to a ridge. Just above the lower end of the horn-core there is a broad flattened flange, the upper portion of which is broken away in a V-shaped notch just below a knob-like projection on the antero-lateral border. This flange has an S-shaped, curved anterior border which arches forwards, upwards and laterally; then upwards, medially and forwards; and then upwards, medially and backwards. The antero-lateral border of the horn also has two other knobs, and there is a small rough projection just above the highest knob. Just above knob 2 the horn becomes more circular and tends to narrow (A–P) rapidly. The tip of the horn is broken off; but it appears to have pointed horizontally, medially and backwards.

This specimen is noted by Hopwood (1936).

There are deep grooves on the antero-medial surface, which sweep up from the base more or less parallel to the anterior and posterior borders. On the postero-medial surface of the horn-core there are less marked grooves present, some of them being along the axis of the horn, while others are transverse.

Length along the posterior border	560
A–P length across the broadest part of the flange	190
A–P length at the highest part of the flange (knob 2)	165
Breadth (side-to-side) at highest part of flange (knob 2)	85
A–P length at knob 3	117
Breadth (side-to-side) at knob 3	54
A–P at knob 4	88
Breadth (side-to-side) at knob 4	53
A–P at distal extremity of the horn	46
Breadth (side-to-side) at distal extremity of the horn	40

Table 20. Measurements of M 14955 (mm.).

B. Fragments of Jaws

F 3655 *Oldoway II: in situ* 1941, *with others marked 'A'* (plate 4)

It consists of a large fragment of a right maxilla, a portion of the right palatine bone also being intact. It contains M^3, M^2 and M^1. The teeth are in a very worn state; M^1 in particular has been worn almost to the crown-root junction on its anterior pillar.

Buccal surface. The cingulum is rather marked especially in M^3. In M^2, however, the buccal surface is almost completely broken away. Continuous with the rounded cingulum in M^3 and M^2 is a very prominent parastyle, a mesostyle and a metastyle, the parastyle being particularly large and the metastyle being rather rounded. The metastyle of M^2 is almost absent, being heavily impacted against the anterior pillar of M^3, and the enamel in that region is also worn away. The prominence of these styles is most marked on the third molar.

Lingual surface. Rather coarse rugosity. On each tooth there is a cingulum below which there is a slight bulge.

Occlusal surface. The central pits of M^3 and M^2 are U-shaped, although the enamel on the buccal aspect of the pit tends to be rather V-shaped. In M^3 the enamel of the central pit of the posterior pillar is irregular on the lingual side. In M^2, where there is more wear, the limbs of the pits which sweep towards the styles are more or less obliterated; and this is even more obvious in M^1 where the central pit is completely obliterated in the anterior pillar, while the posterior pillar has a small irregular island of enamel remaining, representing the central pit.

On the posterior surface of the posterior pillar of M^3, there is a sharp indentation of the enamel which is also reflected on the root. The posterior buccal root of M^3 is massive and triangular. The buccal roots of the teeth can be seen as the bone is broken away over them, while only the base of the lingual root can be seen, and there are no significant differences in appearances between these and the usual giraffid pattern (*vide supra*).

6 *Old. BK II* (plate 7).

The body of a right mandible, containing M_3–P_2. The vertical axes of M_3 and M_2 are tilted forwards. The enamel of all the teeth is fairly rugose (except for P_2).

M_3 has a rounded cingulum. The rugosity cannot be determined as the enamel is covered by a thin layer of breccia. There is a rudimentary ectostylid and protostylid similar to those of Old. 1 (*vide infra*). The talonid is slightly angulated to the A–P axis of the pillars in a buccal direction.

M_2, M_1 and P_4 have features similar to those of M_3.

P_3 is similar to P_3 of specimen 365 (*vide infra*), except that the paraconid is more separated from the parastylid by a 'pinching in' of the enamel.

P_2

Buccal surface. Finely rugose. There is a rounded cingulum.

Lingual surface. There is a slight cingulum. The parastylid and the metastylid are present.

Occlusal surface. The tooth-shape is triangular. The buccal surface is slightly rounded and the apex of the tooth points anteriorly. The posterior surface of the tooth is markedly worn away.

Wear. The teeth are in advanced wear. On the anterior surface of M_3, the enamel is thinned by 'impaction' of the posterior surface of M_2. On the anterior surface of M_2 the enamel is almost completely worn away; a similar thinning is seen on the contiguous surfaces of M_1 and P_4 where the enamel is completely absent. The contiguous surfaces of P_4 and P_3 show loss of enamel, as does the posterior surface of P_2, but the anterior surface of P_3 has its enamel only slightly thinned. Maximum wear on the premolar is found on the posterior occlusal surface on the buccal side.

Roots. Those of P_2 are broken away on the buccal side, but there are two roots rounded in shape and they are continuous with each other on the area visible above the alveolus, which is about 10 mm.

F 3656 *Oldoway* 1941, *S II* (plates 5(*b*), (*d*); 6(*a*))

A portion of a fragmented left mandible, containing M_3, M_2 and a part of M_1.

M_3

Buccal surface. There is a cingulum on the posterior pillar and talonid, but on the anterior pillar there is a slight depression in the cingulum region and there is an unusual ridge of enamel a few millimetres above the crown-root junction. The rugosity is coarse. The tooth is in a rather advanced stage of wear.

Lingual surface. Rather rugose. Marked cingulum formation. On the posterior surface of the talonid the 'abnormal cingulum' arrangement is also present. Leading up from the cingulum there is a slight entostylid and a slightly more marked parastylid, while the metastylid cannot be detected. The median costa of the entoconid is more obvious than that of the metaconid. The talonid is rounded and its axis is deviated buccally at an angle of about 40° to the A–P axis of the two pillars.

Occlusal surface. The two sides of the central pit of the anterior pillar are in close contact, except anteriorly where they are separated by a small triangular

space. The sides of the central pit of the posterior pillar are slightly more separated than in the anterior pillar, and there is a protrusion of enamel in the direction of the talonid. The anterior pillar is more rounded than the posterior pillar, the peripheral enamel of the posterior pillar being more V-shaped than that of the anterior pillar, which is rather U-shaped. Enamel of the anterior surface, where in contact with the posterior pillar of M_2, is almost completely worn away.

M_2

Buccal surface. There is a cingulum with a rounded bulge above it. Coarse rugosity. Its characteristics are generally similar to those of M_3. The posterior surface of M_2 is worn away where it meets M_3, and the anterior surface where it meets M_1 is very worn, as is the posterior surface of M_1, at least half of the surface of which has no enamel whatsoever.

M_1. A part of the anterior pillar is missing.

1 *Old. BK II* (plate 6(*c*), (*d*), (*e*))

This specimen consists of a portion of the body of a right mandible containing M_3–P_4 in a fairly advanced stage of wear.

M_3

Buccal surface. The enamel is coarsely rugose. There is a rounded cingulum which is particularly marked on the anterior pillar and the talonid. There is a very large ectostylid; and there is a slight bulge above the cingulum of the anterior pillar, but the posterior pillar does not show this and near the occlusal surface of both there is a slight concavity of the enamel surface.

Lingual surface. The enamel is coarsely rugose. The cingulum is present, forming a rounded bulge in the region of the base of the entoconid. The features are similar to M_3 of Old. 6. The lingual surface is cracked and the whole crown has been forced lingually.

Occlusal surface. No additional features, except that the enamel is very thick.

M_2. On the buccal surface the features are similar to those of M_3. On the lingual surface the enamel of the posterior pillar is broken away. The appearance otherwise is similar to that of any M_2 described here.

M_1

Buccal surface. There is a great similarity to M_2, except that the bulge above the cingulum is more rounded. A distinct nodular ectostylid is present. The other aspects of the tooth are similar to those of any M_1 described here.

P_4. The general description is identical to that of P_4 of specimen 365.

365 *Old. SHK II*, 1953 (plate 8)

Fragment of a right mandible containing M_1, P_4 and P_3. The teeth are in a very advanced stage of wear.

M_1

Buccal surface. The enamel is rather rugose, and the cingulum is present. On the posterior surface of M_1 all the enamel has been worn away, the contact

surface with M_2 being formed by dentine, which itself has been worn away, forming a notch in this surface.

Lingual surface. The enamel has a rather rugose appearance. There is a small cingulum present. No features can be identified because of the marked wear and fragmentation.

Occlusal surface. The central pits are completely worn away, except for a small island of enamel in the posterior pillar. The buccal enamel of the posterior pillar is U-shaped, while that of the anterior pillar is V-shaped.

P_4

Buccal surface. Rather rugose enamel. A cingulum is present, being particularly marked on the hypoconid. A small ectostylid is present between the hypoconid and the protoconid.

Lingual surface. Rather rugose. Cingulum present. The base of the entostylid can be seen. There is a rounded bulge forming the base of the metaconid. The enamel of the posterior surface is worn thin, while that of the anterior surface is worn away completely.

Occlusal surface. The central pit of the anterior pillar is V-shaped, while between the anterior and the posterior pillars there is a small triangular pit. The buccal enamel of the anterior pillar is convex and wide, 'boat-shaped', while the buccal enamel of the posterior pillar is typically in the form of a 'U' compressed from front to back.

Roots. On the lingual aspect, the bases of the roots can be seen. Thus two triangular roots are visible, the anterior being slightly larger than the posterior and they are separated by an inverted V-shaped interval.

P_3

Buccal surface. Coarsely rugose. The cingulum is present, being particularly rounded in the region of the hypoconid.

Lingual surface. Rather rugose. There is a marked rounded cingulum, being particularly marked at the base of the entostylid and not quite as marked at the base of the parastylid. There is a distinct bulge in the region leading up to the metaconid.

Occlusal surface. The whole tooth gives the appearance of an irregular triangle, the buccal surface being more convex than the lingual surface, the apex pointing anteriorly. The posterior surface has its enamel worn away completely, and the dentine has been hollowed out by P_4. The posterior 'pillar' has an irregularly shaped triangular central pit, while all that remains of the central pit of the anterior 'pillar' is a small circular island of enamel surrounding a small pit at the posterior end.

Roots. The root of the anterior 'pillar' has a broad triangular base. It is larger than the root of the posterior 'pillar' which is separated from it by an interval shaped like an inverted V.

Mandible. Because it is highly fragmented and almost completely filled with plaster, it is considered advisable not to take any measurements of the mandible.

392 *Oldoway SHK II E*, 1953 (plate 9)

Fragment of a right mandible containing M_2 and the sockets of M_3 and M_1.

M_2. In an advanced stage of wear.

Buccal surface. The enamel is rather rugose. The cingulum is present, and there is a rounded bulge above it.

Lingual surface. Rugosity is not clear because the tooth is worn smooth on this surface. The cingulum is present. The entostylid and parastylid are present and are continuous with the cingulum at their bases. A metastylid is not present.

Occlusal surface. The lips of the central pit are more widely separated in the posterior pillar than in the anterior.

Roots. The shallow sockets indicate that the roots were short.

3 *Old. BK II* (plate 10)

Fragment of a right mandible with M_3. The tooth is in a fairly advanced stage of wear.

Buccal surface. There is a marked rounded cingulum. Enamel rather rugose. Hypoconulid and ectostylid are present as small nodules. The enamel of the anterior surface of the tooth is broken off, as also the enamel of the lingual surface of the anterior and posterior pillars. The talonid is rather rounded and its axis is in direct line with the longitudinal axis of the anterior and posterior pillars. There is quite a marked V-shaped groove between the enamel surface of the pillars, and also between the posterior pillar and the talonid.

Lingual surface. The enamel of the talonid is rather rugose, and if the talonid is looked at from the posterior aspect the enamel can be seen to bulge and drape down on the buccal aspect in the typical 'apron' effect. The lingual surface of the talonid slopes rather markedly buccalwards and upwards towards the apex from the bulge above the cingulum. The buccal surface has a concavity just above the rounded cingulum.

Occlusal surface. The central pit of the anterior pillar is irregularly U-shaped and closed, while the central pit of the posterior pillar is closed off anteriorly by the enamel of the posterior surface of the anterior pillar, and posteriorly the pit is open and continuous with the central pit of the talonid.

Mandible. Breadth opposite talonid: *c.* 42 mm.

93 *Old. BK II*, 1952 (plates 5(*a*), (*c*); 6(*b*))

Portion of the left mandible, containing M_3 and M_2 and a piece of M_1. The teeth are in a most advanced stage of wear, and the wear is extremely irregular in that the lingual cones of the pillars of M_3 and M_2 have been completely worn down beyond the crown-root junction, while on the buccal aspect a fair amount of enamel is still present. Because this type of wear is the reverse of the usual, it is probable that the cause is a pathological one.

M_3

Buccal surface. The enamel is rather rugose, although it is worn smooth in parts. There is a bulge above the cingulum on the pillars and on the talonid.

Lingual surface. Only the enamel of the talonid and that part where it communicates with the posterior pillar is visible. The talonid is placed at a peculiar angle to the rest of the tooth. Not only is its A–P axis angulated buccally in relation to the mesio-distal axis of the anterior and posterior pillars, but it is also tilted upwards so that its occlusal plane is angulated at 20° to the occlusal plane of the pillars.

Occlusal surface. The central pits of the anterior and posterior pillars are still visible.

M_2

Buccal surface. The buccal portion of the posterior pillar and the roots are broken away, and the surface of the anterior pillar has a rather rugose appearance and a small cingulum.

Lingual surface. The shape of the tooth has been completely disfigured by the abnormal mode of wear, as in the case of M_3.

Occlusal surface. There is a small island of enamel projecting above the surface in the region of the parastylid.

M_1. A portion of the buccal surface of the posterior pillar remains, this pillar being in extreme wear. The rest of the tooth is fragmented and broken away.

92 *Oldoway*, 1952, *BK II* (plate 11)

A fragment of a left mandible, containing M_3 and M_2 and a piece of the posterior root of M_1. The teeth are in early wear and the crown-root junction has not yet appeared above the alveolar surface.

M_3

Buccal surface. This surface is coarsely rugose. The median part of the hypoconid and of the paraconid is rather angulated, especially near the occlusal surface.

Lingual surface. A portion of the mandible is broken away uncovering the crown-root junction where a cingulum can be seen. Just above it there is a bulge, and leading up from the cingulum on the anterior pillar there is a marked narrow parastylid, which does not quite reach the occlusal surface of the tooth. About half-way up from the crown-root junction, the base of the metastylid commences and near the occlusal surface it becomes a prominent ridge overlapping the anterior portion of the entoconid. The median ridge of the metaconid is prominent for about the same distance as the metastylid. The median ridge of the entoconid is prominent, but the entostylid is much less marked. The lower $\frac{2}{3}$ of the lingual surface of the enamel of the anterior and posterior pillars are fused in the region of the metastylid, but the upper $\frac{1}{3}$ is separated by a groove. This surface of the entostylid is continuous with that of the talonid.

Occlusal surface. The tooth is in early wear which is most marked along the anterior portion of the protoconid. The central pits are V-shaped, their hollowed portions being continuous with each other in the region between the two pillars, while the central pit of the posterior pillar is continuous with a small central pit of the talonid. The central pit of the anterior pillar is closed off anteriorly where the enamel of the paraconid fuses with that of the protoconid.

M_2. The general characters of M_2 are similar to those of M_3, except that the entostylid and parastylid are more marked than in M_3, and the metastylid presents a vertical groove which kinks it posteriorly.

91 *Old. BK II*, 1952

This specimen consists of the posterior portion of the left body of a mandible including the angle, and contains M_2, a part of M_1, and the roots of M_3. Owing to previous inaccurate reconstruction M_1 appears to be lower than M_2.

M_2

Buccal surface. Coarsely rugose. Cingulum present. The enamel is thickened above the cingulum of the posterior pillar. A small ectostylid is present. The tooth is in a medium stage of wear.

Lingual surface. Finely rugose; cingulum present. It has the general characters of M_2 described previously. A portion of the metaconid is absent.

Occlusal surface. Shows two central pits; their lips are fairly widely separated, the anterior pit broadening out anteriorly and the posterior pit broadening out posteriorly. The enamel of the anterior surface of the anterior pillar is worn rather thin due to contact pressure of M_1.

M_1. The general description is similar to that of M_2, but it is markedly impacted against M_2, so that its entostylid appears rather squashed.

Oldoway BK II—East Nguntiri site, 1953 (plate 12)

Fragment of an unnumbered left mandible containing M_1, M_2 and the anterior pillar of M_3. It is in an advanced stage of wear.

M_3

Buccal surface. There is a small rounded cingulum above which the buccal surface is flat. Fairly rugose.

Lingual surface. The enamel is chipped away.

Occlusal surface. The anterior pillar has a rounded appearance. The parastylid is small.

M_2

Buccal surface. Rounded cingulum above which the enamel bulges fairly markedly forming a ridge. Fairly rugose enamel.

Lingual surface. It has the general characters of other M_2 described previously.

Occlusal surface. The central pits of M_2 are linear. The posterior pit has an extension up towards the entostylid.

M_1. Rather similar in general appearance to M_2.

321 *Old. BK II Ex.* 1953 (plate 13)

Fragment of a left mandible containing a portion of an anterior pillar of M_3 and a fragmented M_2. It is at the same stage of wear as the Nguntiri specimen.

M_3. The buccal surface of the anterior pillar is rather flattened out and rounded. It has a finely rugose enamel.

M_2. It is in rather advanced wear.

Buccal surface. There is a small cingulum which has a small rounded bulge above it on the anterior pillar. Finely rugose enamel. The anterior surface of the anterior pillar is broken away.

Lingual surface. Fairly rugose. Cingulum present leading up to reach the parastylid and entostylid. The parastylid is prominent.

Occlusal surface. It presents an identical appearance to any other molar at a similar stage of wear. The enamel of the posterior surface of the posterior pillar is slightly thinned out due to contact wear by M_3.

C. Isolated Teeth

F 2989 *Oldoway,* 1941, *II, in situ with 'A'* (plates 15(*e*); 16(*e*); 17(*e*))

This is an isolated upper left premolar, probably P^3 (*vide infra*), in an extremely advanced stage of wear which is reminiscent of that of M^1 of F 3655. The lingual surface is completely worn away, while the buccal surface presents a fairly rugose enamel. Just as the wear is more marked on the lingual surface, so it is more marked on the anterior surface. The base of a rather large and rounded metastyle is present.

Occlusal surface. Only a small slit remains of the central pit, as well as a small island of enamel near the metastyle.

Roots. The lingual root, which is broken off near its tip, is enormous with a rather convex lingual surface and a flattened buccal surface. There are two buccal roots, the anterior one being oval, the posterior one being triangular. The anterior root is broken off near its tip.

The measurement of the mesio-distal length of the root, just above the crown-root junction is 27·1 mm. which compares favourably with the length of the root of the Hopefield P^3 (4025), viz. 29·7 mm.

Determination of the diagnosis of F 2989

In order to determine which upper premolar it is, the premolar index (see Section I) has been calculated.

Morphologically, specimen F 2989 seems to belong to the same individual maxilla as F 3655. Both were found in 1941, 'with A', and they look very

much the same, i.e. degree of wear, type of fossilization, colour of tooth and breccia.

The premolar index for the transverse breadth is $\frac{P?}{M^1} = \frac{43}{47} = 91{\cdot}48$.

In *G. camelopardalis*, the same premolar index for the transverse breadth is

	N	M. & s.e.	σ	V	Range of Variation
$\frac{P^3}{M^1}$	108	$91{\cdot}03 \pm {\cdot}469$	4·84	5·31	73·6–106·2
$\frac{P^4}{M^1}$	108	$95{\cdot}74 \pm {\cdot}458$	4·72	4·93	83·0–109·5

According to these figures, the premolar index of F 2989 is more closely related to that of P^3/M^1 than to that of P^4/M^1, and it should rather be considered as a P^3.

However, it should be noted that 91·48 is different from the mean value of P^4/M^1 by less than one sigma ($95{\cdot}74 - 4{\cdot}72 = 91{\cdot}02$) so that no conclusive significance could be attached to this mathematical approach of the problem of determination, especially in view of the large range of variation.

F 2993 *Oldoway II, with 'A'* (plate 14(*a*), (*b*), (*c*))

Isolated upper right molar, probably M^2. It is in a fairly advanced stage of wear, and has a rather rugose enamel, and a cingulum which is very marked on the anterior pillar. There is a small entostyle and hypostyle.

Buccal surface. The paracone is missing, but the metacone shows the usual characters except that the cingulum is a very marked ridge, and that the central costa of the metacone is not quite confluent with the cingulum at its base. There is a heaped-up ridge of enamel just above the cingulum.

Lingual surface. Below the rolled lower edge of the cingulum, the enamel appears to be thrown into folds.

Occlusal surface. It is typical of the upper molars with no unusual features, except that the enamel surface of the hypocone is quite widely separated from that of the protocone where they tend to come together between the two pillars.

4 *BK II* (plates 15(*b*); 16; 17)

Isolated right M^3, with the metacone broken away. It is in a most advanced stage of wear.

Buccal surface. There is a marked cingulum. The typical formation of the styles are seen here again, but the ridge of enamel leading to the paracone is not very marked.

Lingual surface. The enamel is fairly rugose, but is thrown into ridges forming an entostyle and a small protostyle. There is a cingulum and the tooth bulges below it. Here, as in all other M^3, the posterior pillar projects less in a

lingual direction than does the anterior (cf. Hopefield 4024, Old. 3655). In all other upper molars the posterior pillar projects more lingually.

There is a typical marked angulation of the lingual surface from the base towards the apex in a buccal direction.

Occlusal surface. The central pits are most irregular on the lingual side, the buccal enamel lip being V-shaped, while the lingual enamel is irregularly U-shaped. The pits of the two pillars are in continuity in the region of the mesostyle.

Roots. Typical formation of the lingual root with its more massive anterior portion formed by a vertical depression between the anterior and the posterior portions of the lingual aspect. The buccal roots are roughly triangular in shape, the posterior one being larger, and its tip curves posteriorly.

109 *Olduvai BK II* (1955) (plate 14(*d*), (*e*), (*f*))

Isolated upper left M^3 in early wear, with a portion of the hypocone broken off. The enamel is finely rugose. There is a cingulum present and a very small entostyle, while a ridge of enamel represents both the hypostyle and the protostyle. There is a slight bulge below the cingulum and the lingual surface slopes at a marked angle towards the apex in a buccal direction.

Buccal surface. The cingulum and its styles are typical of the teeth described previously, except that the styles are not as obvious as, for example, in F 3655.

Occlusal surface. The central pits are in continuity with each other. The paracone is rather widely separated from the protocone, but the metacone is closer to the hypocone, and in fact the apex of the metacone tends to be twisted in a lingual direction.

Roots. The roots are broken off at the base.

F 2992 *Olduvai II, in situ with 'A'*

This is an isolated upper molar in a very fragmented state. It is not possible to determine which molar it is and to which side it belongs. It shows characteristics similar to analagous portions of upper molars previously described. It is in a fairly advanced stage of wear.

97 *Old. BK II,* 1952

Isolated right canine with the mesial portion of its enamel broken away. The tooth is in an advanced stage of wear.

Buccal surface. Marked cingulum with a rounded bulge above it. The enamel is coarsely rugose. The tooth is partially bilobed, the outer lobe projecting beyond the true transverse plane of the longest axis of the root.

Lingual surface. The dentine is hollowed out laterally. The occlusal edge shows a broad rim of wear. The occlusal edge of the tooth slopes outwards and backwards.

Crown height	*c.* 32 mm.	Maximum breadth	15·0 mm.
Length	28+ mm.	Tooth height	*c.* 60 mm.

F 2991 *Old. I S*, 1941 (plates 18(*a*); 19(*a*); 20(*a*))

Isolated right P_4, in a fairly advanced stage of wear.

Buccal surface. Coarsely rugose; marked cingulum especially at the base of the hypoconid. A nodular ectostylid is visible.

Lingual surface. There is a cingulum. Rugosity is coarse, although the tooth is worn smooth over the major part. The parastylid and the metastylid are prominent, the parastylid rising up as a distinct ridge from the cingulum. The median ridge of the metaconid is present.

Occlusal surface. The central pit of the anterior pillar is rather wide anteriorly; it narrows in the centre, and then forms an open slit between the metastylid and the entoconid. The posterior pillar has a central pit which has a rounded formation anteriorly and which narrows posteriorly in the region of the entostylid.

Roots. They are broken off near the base, the posterior root appearing large and quadrangular-shaped, the smaller anterior root being somewhat oval with a concavity on its posterior aspect. On viewing the posterior aspect, the 'apron' effect of the enamel is visible.

2 *Old. BK II* (plates 15(*a*); 16; 17)

Isolated right P_4. It has the general characteristics of F 2991, although it is in a slightly less advanced stage of wear. The roots have been repaired and replaced at an abnormal angle.

5 *Old. BK II* (plates 15(*d*); 16; 17)

Isolated left P_4, with the roots broken away. The tooth has just commenced wear.

Buccal surface. It shows a coarse rugosity and a cingulum which is particularly accentuated at the base of the hypoconid. An ectostylid is present on the posterior part of the protoconid.

Lingual surface. Cingulum present. The entoconid shows a marked bulge about half-way up the posterior aspect of the tooth. The median ridge of the metaconid is prominent and there is a distinct metastylid which overlaps the lingual surface of the entoconid and is separated from it by a wide interval near the occlusal surface, but is fused with it near the base of the crown.

Occlusal surface. Two wide central pits are present. The hypoconid is separated from the protoconid by a wide V-shaped interval in the upper $\frac{2}{3}$ of the tooth, but is fused with it in the lower $\frac{1}{3}$ (as in F 2991 and 4).

7 *Old. BK II*

Isolated right P_4. The roots are absent. Part of the base of the anterior pillar is missing, and part of the lingual surface is absent.

Buccal surface. Coarsely rugose, and there is a thick cingulum at the base of the posterior pillar. Very similar to 5, except that the hypoconid is not separated from the protoconid by a wide interval, but only by a furrow, and

that the ectostylid appears here only as a minute nodule. The tooth has just erupted and is not in wear at all.

96 *Old. BK II,* 1952

Isolated left P_4, with a part of the buccal surface, the base and the roots missing.

Lingual surface. Very similar to that of F 2991.

Occlusal surface. Is also similar to F 2991 except that the central pit of the anterior pillar is now closed off and there is a small island of enamel near the parastylid, and the enamel of the entostylid has fused with that of the metastylid.

105 *Old. BK II ex.* 1953 (plates 18(*c*); 19(*c*); 20(*c*))

Isolated right M_1. Part of the anterior root is broken off and a portion of the buccal enamel of the posterior pillar is chipped off.

Buccal surface. A small cingulum is present. The enamel is thickened in the region of the ectostylid. The hypoconulid is formed by a marked vertical ridge, although it is worn away at its base. The enamel is rather rugose.

Lingual surface. Small cingulum. It leads up to a parastylid on the anterior pillar, and on the posterior pillar the entostylid seems to have a rather broad base, and it is separated from the median ridge of the entoconid by a slight vertical furrow. The base of the mesostylid can be identified and it is continuous with the metaconid.

Occlusal surface. The pillars have a rather circular shape. The central pits are slightly curved with their convexities facing buccalwards, the anterior portion of the anterior pit being larger than the posterior portion, while the posterior part of the posterior pit is triangular and its lips are more widely separated than those of the anterior portion of the pit. The buccal enamel of the central pit of the anterior pillar is continuous with the lingual enamel on the entoconid. There is a slight kinking of the enamel in the region of the metastylid.

Roots. The posterior root is broad and curves posteriorly at its tip in an abnormal fashion and on its posterior surface it has a prominent ridge which appears to be continuous with the unusually large hypoconulid. On the posterior aspect of the base of the anterior root there is an aberrant root nodule which has been broken off.

132 *Old. BK II,* 1953

Isolated right M_1, in a very advanced stage of wear. Both roots are broken off at the base.

Buccal surface. Rather rugose. Very slight cingulum. The crown is rounded just above the cingulum. A small ectostylid is present. The anterior surface of the tooth has a piece missing.

Lingual surface. The posterior pillar has almost all its enamel worn down by abnormal wear (cf. specimen 93). The cingulum is barely recognizable on the anterior pillar. The enamel is rather rugose. The base of the central ridge of the metaconid is just recognizable where it fuses with the metastylid.

Occlusal surface. The central pits are irregular in shape. The central pit of the anterior pillar presents a bow-tie effect. The posterior surface has its enamel worn away completely.

95 *Old. BK II,* 1952 (plates 18(*b*), 19(*d*); 20(*d*))

A right M_2. The roots are broken off at the base.

Buccal surface. There is a fairly well-defined cingulum on the anterior pillar which is less marked on the posterior pillar, and a prominent protostylid leads up from the cingulum. There is a small nodular ectostylid prolonged on to the posterior pillar while there is an elevated ridge (hypostylid) on the posterior aspect of the pillar. There is a small hypoconulid present. The enamel is rather rugose.

Lingual surface. There is a small cingulum. The parastylid is broken off and the median ridge of the metaconid is prominent and rounded and is hardly separated from the metastylid, so that the general impression of the anterior pillar is that there is a very broad convex portion on the lingual surface (cf. Old. 120, *infra*). On the posterior pillar, the entostylid is a small narrow ridge and hardly separable from the entoconid. Seen from the anterior or the posterior aspect, the buccal enamel presents the 'apron' effect.

Occlusal surface. The central pit of the anterior pillar is broad anteriorly, while posteriorly it tends to slope towards the metastylid and in the central portion the two enamel surfaces almost approximate each other. The central pit of the posterior pillar presents a U-shaped appearance of the buccal lip of enamel, and a V-shaped one of the lingual lip.

120 *Old. BK II,* 1955 (plates 18(*e*); 19(*e*); 20(*e*))

Isolated left M_3, with most of the roots missing. It has a rolled appearance and is in an advanced stage of wear.

Buccal surface. The pillars have a marked cingulum; on the anterior portion of the posterior pillar, the cingulum is less marked, while it is most marked on the talonid. A short ectostylid is present. The surface is rather rugose. The buccal surface slopes quite markedly towards the apex in a lingual direction. There is no or very slight rounding above the cingulum. A slight cingulum is present on the anterior surface of the anterior pillar.

Lingual surface. Cingulum is marked on the pillars, but least marked on the talonid. Leading up from the cingulum of the anterior pillar, there is a rather marked parastylid; the metastylid is absent, and there is only a minute entostylid. However, the central ridge of the metaconid is extremely broad and rounded while the central ridge of the entoconid is also very large, but it is smaller than the metaconid. Between the entoconid and the metaconid the

enamel folds rather deeply in a buccal direction emphasizing the metaconid and the entoconid even more. The metastylid has fused with the metaconid and thus produces this large bulge, and similarly part of the entostylid has probably joined the entoconid to produce the latter's large size (cf. specimen 95). The talonid is rather large and rounded; a hypoconulid is present. The buccal enamel of the posterior pillar is continuous with that of the anterior pillar but the two pillars are rather separated, which is a general variable feature of the lower molars.

Occlusal surface. The central pit of the anterior pillar is shaped like a bow-tie, in that the anterior portion is triangular in shape, and the central pit is still obvious, as also the posterior portion, but in between the two enamel lips are lying against each other. In the posterior pillar, the central pit has a similar appearance except that the anterior portion is more oval, the posterior portion is narrower and is continuous with the central pit of the talonid, which is fairly large. The enamel is generally very thick in this tooth.

Marsabit Road (plate 14(*g*), (*h*), (*i*))

This specimen has no number. It is a left third lower molar. Part of the talonid is broken off, as well as a part of the anterior surface.

Buccal surface. The pillars have a marked cingulum and it is coarsely rugose.

Lingual surface. Idem. The tooth is in advanced wear. The ridge of the parastylid can just be made out, while the metastylid has fused with the metaconid.

Occlusal surface. The anterior central pit is L-shaped. The posterior central pit is broadly U-shaped, and just behind it there is a rather wide central pit on the talonid. Although the roots are broken, they appear to be very short.

166 *Old. BK II*, 1955 (plates 18(*d*); 19(*b*); 20(*b*))

Isolated right lower molar, probably M_2, in early wear.

Buccal surface. It has a distinct rounded cingulum, more prominent on the anterior pillar than on the posterior one. The enamel shows a coarse rugosity. The ectostylid is represented by a small ridge of enamel. There is a small parastylid and a protostylid present. No hypoconulid. The metastylid is very prominent.

Lingual surface. A well demarcated cingulum leads up to a marked parastylid and a slightly less marked entostylid which however is broken off near the occlusal surface. The central ridge of the metaconid is well defined, and is separated from the metastylid by a slight depression. The entoconid is broken off.

Occlusal surface. The central pit of the anterior pillar is slightly curved and is wider anteriorly than posteriorly. The central pit of the posterior pillar appears to be V-shaped: a part of the pit is broken away.

116 *Old. BK II Ex.* 1953 (plates 15(*c*); 16(*c*); 17(*c*)).

Isolated right lower molar, just commencing wear, with the hypoconid missing and a portion of the entoconid broken. The roots are broken. It is probably a M_1.

Buccal surface. The cingulum cannot be observed because the tooth has been broken away. Surface coarsely rugose.

Lingual surface. The parastylid is a marked ridge. The central ridge of the metaconid has a ribbed appearance, and a prominent metastylid is on the upper half of the tooth; the central ridge of the entoconid also has a ribbed appearance.

8 *Old.*

An isolated pillar of a left lower molar in early wear.

Buccal surface. There is a rounded cingulum present. Small ectostylid. Rather rugose.

Lingual surface. Small cingulum leading up to a small ridged parastylid. The central ridge of the metaconid is only obvious near the occlusal surface.

Occlusal surface. The central pit shows an anterior widening and a posterior narrow part, and the central portions of the enamel surfaces are continuous.

100 *Old. II Ex.* 1953

This is an isolated entoconid of a lower right molar. Wear is just commencing. It presents the general features of entoconids previously described.

98 *Old. BK II,* 1952

Broken isolated fragment of the entoconid of a lower right molar.

99 *Old. BK II,* 1952

An isolated fragment of a lingual pillar of an upper molar.

Marsabit Road

This specimen has no number. It is the posterior pillar of a right lower M_3 with a small fragment of its root. It is in advanced wear and has the general characteristics of M_3 specimens previously described, except that its buccal pillar is markedly twisted posteriorly. The central pit is V-shaped and it has an irregular infolding of enamel posteriorly. There is a marked ectostylid present.

The only measurements that can be taken are:

Maximum breadth	*c.* 32 mm.
Occlusal length	24·0 mm.

Oldoway Surface (plates 18(*f*); 19(*f*); 20(*f*))

It is a right lower molar, probably M_1 in an intermediate stage of wear. Most of the posterior pillar and root are absent, and the anterior portion of the anterior pillar is broken away.

Buccal surface. Enamel rugose; cingulum is present and there is a slight bulge above it.

Lingual surface. Fairly rugose, but worn smooth. The parastylid and the metastylid are well defined.

Occlusal surface. Central pit has a typical bow-tie appearance.

Note.—The measurements of all the teeth are given in table 40 at the end of section 2.

D. Postcranial Skeletal Remains

116p *Old. BK II*, 1952 (plate 23(*d*))

The letter 'p' has been added to this number by the authors so as to differentiate it from the dental fragment with the same number (*supra*).

Proximal end of a right ulna. This presents a massive olecranon process which is separated from the articular facets by a massive rectangular 'slab' of bone. The shaft of the ulna is broken off.

Olecranon process (posterior extremity) to articular facet along superior border	184 mm.
Olecranon process, maximum height	117 mm.
Olecranon process, maximum side-to-side breadth	78 mm.
Breadth at centre of the 'slab'	30 mm.
Maximum breadth of articular process	94 mm.

Most of its articular surface (i.e. about $\frac{7}{8}$) is for articulation with the humerus; only two small facets below this are for articulation with the radius. The surface area of the radial articulation is relatively less than in the modern giraffe.

115 *Old. BK II*, 1952 (plate 21(*b*))

Distal epiphysis of a right radius presenting a marked inferiorly projecting tuberosity.

Maximum breadth at radial tuberosity	122 mm.
Maximum breadth at proximal end of fragment	135 mm.
Maximum A–P length	82 mm.

341 *Old. BK II*, 1952 (plate 21(*e*))

Os magnum of the left carpus: very similar to that of modern giraffe.

Maximum length A–P	75 mm.
Maximum breadth	70 mm.
Maximum thickness of postero-lateral side	39 mm.

114 *Old. BK II*, 1952 (plate 22(*a*))

Distal end of a metacarpal and a piece of the distal shaft: fragments have been broken off, and the distal end has been chipped and rolled. In comparison with the distal end of the metatarsal (*vide infra*, specimen 314) the shaft presents a definite flattened appearance, convex anteriorly and scooped out posteriorly. It is almost identical in appearance to a specimen described by Dietrich (1937), E 122 from Oldoway (his text-figs. 1 and 2, and table VI, fig. 1), and another from Serengeti (Garussi-Korongo 1.39) also described by Dietrich (1942) (his table XXII, fig. 187). The latter specimen is still a young individual with an epiphysis; specimen 114 from Olduvai has a fused epiphysis and the distal end appears to be broader.

Maximum breadth across condyles	105 mm.
Maximum breadth of lateral condyle, taken anteriorly ..	51 mm.
Maximum breadth of medial condyle, taken anteriorly ..	52 mm.
A–P length of the condyles	54+ mm.
60 mm. above the distal end: A–P of the shaft	42 mm.
Breadth of the shaft	79 mm.

100 *Old. BK II*, 1952 (plate 23(*c*))

Distal extremity of a right femur, consisting of 2 condyles and the patellar condyle.

Maximum breadth across the condyles..	161 mm.
Maximum breadth across medial condyle	72 mm.
Maximum breadth across lateral condyle	55 mm.
Maximum breadth across patellar condyle	78 mm.
Cord length of the patellar condyle in the centre	109 mm.

101 *Old. BK II*, 1952 (plate 21(*c*))

Distal end of a left tibia which articulates with numbers 102, 103. Adult. It presents a marked bulge above the medial malleolus and another large rough tuberosity on the antero-lateral aspect just above the articular surface. Leading down from the shaft to this tuberosity there is a large linear ridge.

Distal extremity: Maximum A–P	83 mm.
Maximum breadth	120 mm.
About 80 mm. from distal end: A–P	64 mm.
Breadth	87 mm.

112 *Old. BK II*, 1952

Distal extremity of a right tibia, which is similar in many respects to 101, except that it is smaller.

Distal extremity: Maximum A–P	83 mm.
Maximum breadth	109 mm.

103 *Old. BK II*, 1952 (plates 23(*a*), (*b*); 24(*c*))

Left calcaneum, articulating with 102 and 104. It is a massive bone with a markedly prismatic proximal tuberosity (*tuber calcis*). The body of the bone is broad from front to back, and constricted from side to side. The facet articulating with the posterior surface of the astragalus (talus) is irregular in shape, and has a narrow downward and posterior projection, while it is broad and quadrangular above this. The fibular facet, for articulation with the fibular sesamoid, is quadrangular in shape, convex from front to back and is angulated from behind forwards in a medial direction. At the distal extremity, on the inferior aspect of the lateral side, there is a concave articular facet arched upwards for articulation with the cuboid; it has a lateral convex border, and medially it has a concave border.

108 *Old. BK II*, 1952

A left calcaneum, shorter than 103, presenting roughly the same features, except (1) that the tuberosity is more rounded and massive, (2) that the body is shorter, and (3) that the fibular facet is smaller and more angulated medially.

	103	*108*
	mm.	*mm.*
Maximum length of calcaneum	216	198
Maximum breadth (side-to-side) of tuberosity	69	67
Maximum height (A—P) of tuberosity	69	*c.* 62
Maximum length (A—P) opposite the fibular facet ..	89	91
Body length from the superior border of astragalus facet (along the anterior border)	131	*c.* 119
Minimum body breadth	39	42
Fibular facet: A—P length (on the convex portion) ..	39	33
Breadth	28	24

TABLE 21

102 *Old. BK II*, 1952

Astragalus (talus), belonging to the left side, articulating with the distal end of the tibia No. 101 proximally, and with No. 104 distally, and with No. 103 posteriorly. The proximo-lateral articular ridge, for articulation with the lateral fossa of the tibia, is large and wide, whereas the medial articular ridge is narrow and has a large articular surface on its medial aspect for the medial malleolus of the tibia. On the lateral aspect of the bone, just behind the mid-point, there is a big oblique quadrangular-shaped surface for the articulation of the calcaneum, and at the anterior end there is a small irregularly rounded facet for articulation with the anterior extremity of the calcaneum. Between these two surfaces there is a rough, hollowed-out region for the interosseous ligament. On the anterior aspect, the fossa for reception of the lower border of the tibia is long and saddle-shaped.

107 *Old. BK II*, 1952 (plate 21(*a*))

Right astragalus, with features similar to those previously described in specimen No. 102. Because of the proximity of their discovery, they probably belong to the same individual. Articulates with No. 110.

	102 mm.	107 mm.
Maximum proximo-distal length	113	112
Maximum A—P diameter, medially ..	73	71
Maximum A—P diameter, laterally ..	64	63
Maximum breadth, proximally	87	86
Maximum breadth, distally	c. 75	76
Maximum articular breadth proximally ..	74	73
Maximum articular breadth distally ..	c. 75	76

Table 22

104 *Old. BK II*, 1952 (plates 21(*d*); 24(*g*))

A left cubonaviculare, articulating proximally with astragalus No. 102 and calcaneum No. 103, distally with cuneiform No. 105 and metatarsal No. 106. Proximally, the medial facet for articulation with the astragalus is much broader than the lateral one, the two being typically separated by a ridge. The tuberosity of the naviculare is short but very broad and massive. Laterally, on the proximal surface, is the bean-shaped facet for articulation with the calcaneum. On the distal surface, the articular facet of the cuboid which articulates with the upper surface of the lateral metapodial is longer and broader than the medial articular facet of the naviculare for the fused cuneiforms. Posteriorly to this facet and continuous with it, there is a small rounded facet for the external cuneiform. Posterior to the cuboid articular facet for the metatarsal, there is a well-defined groove which runs transversely. Posterior to this groove there is a tuberosity which does not have an articular facet for articulation with the metatarsal. This facet is present in the modern giraffe.

109 *Old. BK II*, 1952

Isolated right cubonaviculare. The features are very similar to those described in the previous specimen (104).

110 *Old. BK II*, 1952

Right cubonaviculare, articulating with No. 107, 110 A and 111. It has identical features to No. 104. Probably belongs to the same animal.

	104 mm.	110 mm.	109 mm.
Maximum breadth (side-to-side) across the centre	110	108	101
Maximum A–P length across the tuberosity of naviculare	106	106	95
Maximum length of naviculare articulating facet for cuneiform	55	55	48
Maximum breadth of naviculare articulating facet for cuneiform	37	37	35
Maximum length of cuboid articulating facet for metatarsal	61	61	55
Maximum breadth of cuboid articulating facet for metatarsal	45	48	42

Table 23

105 *Old. BK II*, 1952 (plate 21(*g*))

Left cuneiform consisting of the fused I and II cuneiforms. It has an oval shape. It articulates with No. 104 and 106. The proximal surface is concave from front to back. The distal surface is slightly convex in the central portion. Medially and posteriorly there is an irregular prominence, the upper border

of which is in the same plane as the articular facet. On the surface of this prominence are a number of almost parallel grooves which run from above in a downward and forward direction: they are probably grooves formed by the astragalo-metatarsal ligament. On the antero-medial part of the superior border, the articular surface has a small lip which projects downwards. It articulates with a similarly shaped small projection on the cubonaviculare, at the junction of the cuboid with naviculare, at the antero-medial part of the opposing facet.

110 A *Old. BK II*, 1952

A right fused cuneiform, articulating with No. 110 and 111. It is identical in appearance to No. 105, but its posterior portion is broken off.

	105	*110 A*
Maximum A–P length	68 mm.	59 mm.
Maximum breadth side-to-side	41 mm.	40 mm.
Maximum thickness (postero-lateral)	23 mm.	23 mm.

106 *Old. BK II*, 1952 (plate 24(*a*), (*b*), (*f*))

This is a proximal end of a left metatarsal and a piece of the shaft. It articulates with Nos. 104, 105. The anterior median groove is extremely wide with marked ridges on each side. Proximally are three articular facets—two are kidney-shaped facets for the cubonaviculare, while in between them and slightly medially and posteriorly is the facet for the small rounded external cuneiform.

111 *Old. BK II*, 1952

Proximal end and portion of the shaft of a right metatarsal, showing similar features to 106. It articulates with Nos. 110, 110 A.

	106 *mm.*	*111* *mm.*
Maximum length (A–P) at proximal end	81	84
Maximum breadth at proximal end	93	95
About 60 mm. below: A–P of shaft	67	65
Breadth	65	72
Maximum A–P of medial articular surface	59	59
Maximum A–P of lateral articular surface	64	58
Maximum breadth across centre of medial articular surface	33	36
Maximum breadth across centre of lateral articular surface	40	*c.* 50

TABLE 24

314 *Old. BK II, Ex.* 1953 (plate 24(*d*), (*e*))

This is the distal third of a right metatarsal. It presents a deep and wide central groove anteriorly, of which the lateral lip is more prominent and higher than the medial. The anterior surface has a general convex appearance, while the posterior surface is flattened. Posteriorly a shallow and ill-defined groove can be seen centrally, leading down to the space between the trochleae ('Rollen', Dietrich, 1942). On the outer aspect of each trochlea, there is a

fossa for the attachment of collateral ligaments, and the lateral one is deeper and larger than the medial. Above the medial fossa there is a rough tuberosity which is larger than the lateral. The trochleae are big and separated by a deep groove; at the base of the groove, where fusion has occurred, there is an extensive central pit extending upwards. The grooves for the sesamoid bones are shallow, the deepest one being the most lateral.

Maximum breadth at the trochleae	109 mm.
Breadth of the lateral trochlea	52 mm.
Breadth of the medial trochlea	53 mm.
A–P length across the trochlea, medially	61 mm.
laterally	63 mm.
Breadth of the distal extremity across the tuberosity	102 mm.
Shaft some 120 mm. above the distal extremity	
maximum breadth	67 mm.
maximum A–P	*c.* 60 mm.

M 14687

This is an articulated hind limb in the British Museum (Nat. Hist.) and Hopwood's paratype (1934). The femur, proximal end of the tibia and the 2nd and 3rd phalanges are missing. The measurements (mm.) are:

Tibia	
Total length	400+
Length: crest of tibia—distal extremity	230
Distal extremity: Maximum A–P	71
Maximum breadth	103
Metatarsal	
Maximum length	411
Proximal extremity: Maximum A–P	81
Maximum breadth	83
Distal extremity: Maximum A–P	54
Maximum breadth	90
Phalanx I	
Maximum length	104
Proximal extremity: Maximum A–P	50
Maximum breadth	48
Distal extremity: Maximum A–P	30
Maximum breadth	40

113 *Old. BK II*, 1952

185 *Old. BK II, Ex.* 1953 (plate 22(*c*))

F 364 *Old. S I*, 1941 (plate 22(*b*))

Old. 'Surface' (plate 22(*d*))

F 3297 *Old. II*, 1941, *with 'A'*

F 365

These are all proximal phalanges and it is not possible to say with any degree of certainty whether a particular phalanx is a medial phalanx of the right limb or whether it belongs to the lateral side of the left limb; or whether a lateral phalanx of the right may belong to the medial side of the left. Furthermore, it is not possible to state whether an individual phalanx belongs to the fore or hind limb; but we have observed that in one particular extant animal the proximal phalanx of the fore limb is more massive than that of the hind limb. On this basis it is suggested that specimen F 3297 and 'Oldoway surface' probably belong to fore limbs, while the other four specimens probably belong to hind limbs.

	185	*113*	*F364*	*Surface*	*F3297*	*F365*
			(*mm.*)			
Maximum length	107	108	113	120	—	114
Breadth (side-to-side) at base ..	50	*c.* 51	44	60	60	52
A–P at base..	54	*c.* 51	48	58	57	51
Minimum breadth, shaft	46	43	37	47	—	39
Distal extremity:						
Maximum breadth (side-to-side)	48	49	46	58	—	48
Maximum A–P length	33	34	29	38	—	31

TABLE 25

342 *Old. BK II*, 1952 (plate 21(*f*))

Sesamoid bone articulating with the head of the middle phalanx and the base of the distal phalanx.

Maximum A–P	53 mm.
Maximum breadth	36 mm.
Maximum thickness	34 mm.

CHAPTER 2

ORANGE FREE STATE (UNION OF SOUTH AFRICA)

A. LOCALITIES

Fossil Sivatheriinae have been recovered from five different localities of the Orange Free State which extend over a large area (the furthermost points being about 150 miles apart), but they all belong to the Vaal River basin (fig. 18). Consequently, in spite of the fact that some of the specimens have been described by different individuals, that they have been found at various stratigraphical levels and that they are housed in different museums, the general geological picture of the Vaal River basin (Cooke, 1949) provides good reason to consider them in one group.

The fossil specimens are recorded as being derived from the following sites:

1. MMK 3685 (McGregor Memorial Museum, Kimberley) is stated as

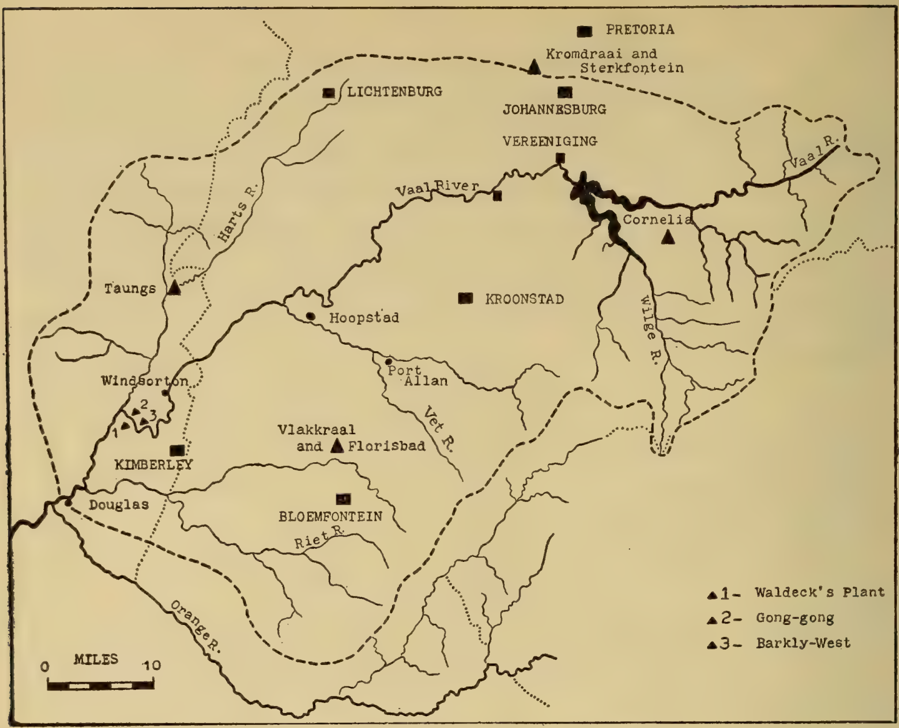

FIG. 18. Map of Vaal River basin indicating major fossil sites (▲) (modified after Cooke, 1949).

coming from an 'unknown locality of the Vaal River basin' (Haughton, 1922). Assigning this tooth to a new genus and species, *Griquatherium cingulatum*, Haughton stated that it came from the collection of Mr. A. Grumpelt at Barkly West, and Cooke (1949) stated that on the basis of the other specimens in this collection, it is quite likely that the *Griquatherium* specimen came from the 60-foot terrace at Waldeck's Plant or Gong-gong.

2. In 1926, three Sivatheriinae teeth were recovered from the upper layers at Florisbad (Dreyer and Lyle, 1931). The actual teeth were sent in 1932 to scientists in Europe for study, but unfortunately they were not described and it is now not possible to trace them. The only remnant of the specimens is a poor plaster-cast of the crown of a lower molar (C 1492) which is housed in the Nasionale Museum, Bloemfontein.

Notes on the geology of Florisbad have been published on various occasions (Dreyer and Lyle, 1931; Dreyer, 1938; Hoffman, 1953; Oakley, 1954a; Singer, 1956, and Meiring, 1956). Oakley (1954a, page 84) states:

'The Florisbad deposits consist of sands, intermittently ejected by springs of gaseous water during Pleistocene and recent times, alternating with seams of peat formed by salt marsh vegetation which spread across the area when the springs were quiescent. There are two parallel lines of spring centres (or

"eyes") which have become sealed off progressively in an easterly direction. Thus the "eyes" are fossilized on the western side of the site but still active on the eastern side.

'Fossil mammalian bones and teeth and Stone Age implements occur in the beds of sand formed by the spring waters during Pleistocene times. Owing to the occasionally disruptive action of the springs, when old "eyes" are reopened, it is not always possible to be sure of the original stratigraphical position of specimens found in these deposits. The most reliable finds are those from below uninterrupted seams of peat.'

Despite deficient data (Dreyer and Lyle, 1931, p. 5, and the Nasionale Museum Register), Oakley (1954a) seems to have obtained information somewhere that *a* tooth of the extinct Sivatherine (*Orangiatherium*) was found between Peat II and Peat III.

3. A horn-core fragment, the type specimen of *Orangiatherium vanrhyni* v. Hoepen, was merely mentioned by van Hoepen (1932). He also mentioned 'a terminal fragment of a large antler and a series of large teeth, which were probably associated'. These specimens, presently housed in the Nasionale Museum and registered under the numbers C 431A, C 431B, and C 426 respectively, are derived from the farm Tierfontein, on the Vet River, 9 miles from Port Allan (personal communication from the Director of the Museum, Dr. A. C. Hoffman) (fig. 18).

4. Specimen F 39 (Archaeological Survey of the Union of South Africa, Johannesburg) is stated by Cooke (1949) to be derived from 'an unknown locality in the Vaal River basin'. This is the type specimen of *Griguatherium haughtoni* Cooke.

5. Two Sivatherine upper milk molars were identified in the collection of specimens from Cornelia, in the Nasionale Museum, Bloemfontein, by one of us (R.S.): these specimens are not registered and are allocated B^1 and B^2 by the authors.

The Cornelia site consists of a large erosional area adjacent to a small branch of the Vaal River. Specimens are found on the floors and on the sides of 'dongas' (eroded clefts) which are washed by seasonal rains and partly covered by flooding of the nearby river, and consequently there are numerous redepositions. The surface consists of hardened calcited sand which rests on varying projections of Karoo formations. A typical view of the site is shown in plate 5 of Oakley's above-mentioned paper (1954a).

B. List of Material and Description

MMK 3685	:	Isolated left M^3—Vaal River (? Waldeck's Plant).
C 1492	:	Cast of occlusal portion of left M_2—Florisbad.
C 426	:	4 isolated upper molars (right M^2 and M^3, left M_1 and M^2)—Tierfontein.
C 431	:	Left posterior horn-core and a right (?) anterior horn-core (ibid.).
F 39	:	Stated to be an isolated anterior pillar of a lower left M_2 or M_3—Vaal River (unknown locality).
B^1 and B^2	:	Isolated right DM^3 and DM^4—Cornelia.

I. HORN-CORES

C 431

There are two specimens marked C 431 from *Tierfontein*. The one is an almost complete posterior horn-core with the tip missing, and this is here designated C 431 A. The other, C 431 B, is a fragment of an anterior horn, and not a part of A.

C 431 A (plate 29(*c*), (*d*))

This is a left posterior horn-core (*vide infra*, 'Discussion'), the base of which is pear-shaped, the narrower portion being anterior. The apex of the hollowed-out portion of the base, formed by sinuses, is 27 cm. distant from the broken edge of the base. From the base, the anterior border runs outwards in a gentle arc towards the first knob, then upwards and slightly medially and then laterally, giving the broad surface of the horn a double twist.

The horn is flattened from side to side opposite the first and second knobs, but above these it tends to bulge where the anterior border becomes rounder.

Grooves on antero-medial surface (cf. Old. 3.53)

From the base there are three fairly deep and broad grooves starting near the front at almost a single point and running obliquely up and back at an angle of about 45°. The most medial groove ends in a trifurcation at the posterior border opposite the first knob. Along the antero-lateral border, at the base of the broken-off flange, three deep grooves pass vertically up parallel to the border. Just below the first knob they tend to deviate from each other, the anterior one running along the anterior border and, passing behind (lateral to) the second knob, it divides into a number of smaller grooves running up almost parallel to each other towards the tip.

Between the levels of the first and second knobs there are four other deep main grooves on the convex surface which run up this surface fairly parallel to each other. The posterior one divides into three just below the level of the second knob, and these then pass towards the posterior border and run laterally.

The anterior border in the region of the flange has two irregular rough tuberosities with numerous vascular foramina. There are, in all, three knobs, very crinkly in appearance and fairly evenly spaced from each other. Between them are two small raised irregular tuberosities.

Circumference at base	*c.* 360
Circumference between flange and knob 2	*c.* 345
Circumference 100 mm. above knob 2	258
Circumference at knob 3	255
Circumference at tip	—
Total length	570+

	A–P	Side-to-side
Base	c. 135	c. 87
Between flange and knob 2	137	79
Above knob 2 (100 mm.)	93	71
At knob 3	97	65
At tip	—	—

TABLE 26. Measurements of C 431 A (mm.).

C 431 B (plate 29(*a*), (*b*))

This is an anterior horn, probably right (if the grooves are taken to be on the medial side). The base is flat from side to side and rather triangular with the broad end posterior. Hollowing-out the base are three cranial sinuses.

The medial surface is extremely irregular with numerous ridges formed by deep grooves. The grooves are deeper anteriorly and commence at the base of the anterior border and pass in an inverted triangular fashion, the anterior grooves being vertical and the posterior oblique. The anterior groove branches about half-way up. The posterior part of the medial surface is roughened by small, shallow grooves. The anterior border has a knob just above the base—it has a cauliflower appearance and is distorted by (? vascular) grooves. The top of the anterior border has another similar knob. The superior surface is very irregular and grooved, the central portion being smooth. The posterior border is concave, the upper end passing backwards and there is one small protuberance at the base and one at the upper end. The outer surface is rather smooth with a single deep groove near and parallel to the anterior border.

Circumference at base		280
Circumference at tip		320
Total length: Anterior		c. 220
Posterior		c. 170
	A–P	Side-to-side
Base	c. 111	c. 70
Middle (opposite knob) ..	113	55
Tip	123	61·5

TABLE 27. Measurements of C 431 B (mm.).

2. TEETH

MMK 3685 (plate 25)

An isolated upper molar in a medium stage of wear, with the roots broken off near the base. This is the type specimen of *Griquatherium cingulatum* Haughton. Although it was originally described as a second molar (Haughton, 1922), and stated by Cooke (1949) to be either a M^2 or a M^3, it is here considered to be unquestionably a third molar because of the relative decrease of the lingualward projection of the posterior lingual pillar compared to the anterior one (*vide infra*).

Buccal surface. Each pillar has a marked cingulum, that of the anterior pillar leading to the broad base of the rounded marked parastyle. The central median costa of the paracone is fairly distinct, the bulge commencing about half-way to the occlusal surface.

The mesostyle is distinctly prominent, projecting out markedly in an anterior direction from the surface of the pillar and having a broad base continuous with the cingulum of the posterior pillar on the one side and with the cingulum of the anterior pillar on the other side, though in the latter there is a slight vertical groove partly separating them. The vertical median costa of the metacone is narrow and hardly prominent, commencing near the base just above the rolled edge of the cingulum. Posteriorly, the cingulum of the posterior pillar is continuous with the bulging base of the short metastyle.

Lingual surface. The enamel is rather rugose. On the anterior pillar there is a marked rounded cingulum, the lower border (the one towards the occlusal surface) of which increases in thickness on the anterior surface producing an unusually long, rolled and ridged protostyle. The cingulum of the posterior pillar is relatively small and almost absent in the region of the entostyle. On the posterior surface of the posterior pillar the actual cingulum remains small and ridged but a distinct elongated crest forms an unusual hypostyle. The lingual surface slopes towards the occlusal surface at an acute angle from the cingulum, but near the occlusal surface the angulation changes and the lingual surface tends to become slightly more vertical. The slope of the buccal surface on the other hand is almost vertical.

Occlusal surface. The central pits have widely separated enamel surfaces, the pit of the anterior pillar being acutely V-shaped and closed anteriorly by the anterior limb of the protocone. The central pit of the posterior pillar has a more obtuse V-shape, being closed posteriorly in the region of the metastyle, but open anteriorly and continuous with the space between the enamel surface of the contiguous side of the protocone and the hypocone. The occlusal surface of the posterior pillar is abnormally longer than that of the anterior, the ratio being 114.4 (table 28).

Measurements (mm.) and indices	*Sivatheriinae* M^2 (*Mean*)	*Sivatheriinae* M^3 (*Mean*)	*MMK 3685*
$\frac{\text{Occlusal length posterior pillar}}{\text{Occlusal length anterior pillar}} \times 100$ ..	100·2	83·9	114·4
$\frac{\text{Maximum breadth posterior pillar}}{\text{Maximum breadth anterior pillar}} \times 100$ ..	99·1	91·1	91·1
Maximum tooth length	47·6	51·5	53·8
Maximum tooth breadth	49·7	48·7	54·6

TABLE 28

From the table, the ratio of the breadth of the posterior pillar relative to that of the anterior pillar corresponds closer to that of four other Sivatherine M^3 than to that of two Sivatherine M^2. From observations on the extant material this ratio in M^3 is a very constant one, and consequently, despite the fact that the ratio for the relative occlusal length appear nearer to that of M^2, the authors consider that MMK 3685 is a M^3. The length and the breadth of the tooth are at the outer limits of the range of Sivatherines (tables 28, 40).

C 1492 (*Cast*)

This is a plaster reproduction of the occlusal portion of the crown of a left M_2. Observations on the cingulum are impossible and what can be made out from the enamel of the cast, it appears to be fairly rugose. The tooth does not appear to be in an advanced stage of wear.

Lingual surface. There is a prominent metastylid and the buccal enamel of the metaconid is continuous with the lingual enamel of the entoconid. The parastylid is slightly prominent. The central costa of the metaconid appears rather flattened.

Occlusal surface. The anterior pillar is more rounded than the posterior pillar on the buccal aspect; the central pit of the anterior pillar is ill-defined, but that of the posterior pillar shows a fairly wide central portion, narrow anteriorly and broad posteriorly.

C 426

This number is given to four upper molars. The authors have subdivided them into A, B, C and D which will be entered in the register of the Nasionale Museum, Bloemfontein. A and B belong to the same individual because of the obvious contact surfaces.

C 426 A (plates 26(*a*); 27(*a*); 28(*a*))

This is a right M^3 in an extreme degree of wear. Part of the paracone is missing.

Buccal surface. A cingulum can be seen, especially in the region of the base of the metastyle where it is considerably heaped up. There is no cingulum in the region of the base of the mesostyle and the surface between meso- and metastyle has been hollowed out, in the same 'W' formation as other teeth described previously: there is a slight bulge in the region which leads up to the apex of the metacone. The paracone is almost completely absent.

Lingual surface. Finely rugose. On the hypocone the rugosity is extremely fine with additional transverse striations. On the anterior aspect of the protocone the enamel is raised slightly at one spot, but the rest of this surface is extremely smooth due to contact pressure, and this wear has even extended on to the base of the root in this region. On the hypocone there is a very slight cingulum. On the protocone, the cingulum is slightly more marked, but still negligible. On the protocone too, the lingual surface bulges slightly above the crown-root junction, and it can be seen to slope towards the apex in a buccal direction. The posterior surface of the hypocone is worn right down to the crown-root junction, only a small piece of enamel being visible here. Here also, the wear has extended on to the root.

Occlusal surface. Despite the marked wear, the central pits are obvious, the enamel edges of each pit of the anterior and posterior pillars being separated to a fair degree. In the anterior pillar, the pit has an L-shape, the upright of the 'L' extending right up to the parastyle, which is broken off. However a small

island of enamel belonging to this pit can be seen extending towards the mesostyle, but it is separated from the L-shaped portion by dentine which is hollowed out by wear. The pit of the posterior pillar is irregular in shape, the lingual aspect having its enamel thrown into two folds which project into the centre of the pit, and the extremities of the pit extend towards metastyle and mesostyle.

The dentine is particularly hollowed out between the enamel of the lingual surface and that of the central pit. On each occlusal surface can be seen striations which in some places are almost distinct scratches indicating a side-to-side chewing movement of the jaws. The shape of the enamel of the lingual surface viewed from the occlusal side is arc-shaped for both cones, the arc of the hypocone being more flattened than that of the protocone.

Roots. Despite the marked fragmentation, it is possible to identify three roots. The lingual root being composed of two massive pillars joined by a plate, and the anterior pillar being the larger. The posterior buccal root is triangular in shape, while the anterior is broken off at its base and fragmented so that its shape cannot be identified.

C 426 B (plates 26(*b*); 27(*b*); 28(*b*))

This is a right M^2 which is very fragmented, so that only a portion of the enamel of the hypocone on the lingual surface is present, while that of the protocone is absent. Both the metacone and the paracone are missing.

Lingual surface. Rugosity is fairly marked in parts, and there is a small cingulum which tends to have a rounded bulge below it. The anterior surface of the protocone shows some ridging of the enamel just below the small cingulum (protostyle) while the rest of this surface, which is only represented by a small fragment, is very smooth due to contact wear. A small piece of the central pit of the anterior pillar is present, the enamel of the two sides of the pit being separated to a fair degree. The *roots* are represented only by a portion of the lingual root.

C 426 C (plates 26(*d*); 28(*c*))

A left M^2 which is a badly fragmented tooth with only protocone and hypocone and a portion of the lingual root present.

Lingual surface. Rather rugose, with a poorly defined cingulum on the hypocone and a well-defined cingulum on the protocone. On the lingual surface of the protocone, near the occlusal surface, is a ridge of enamel parallel to the cingulum. There is no bulge above either cingulum. The lingual surface of the protocone slopes only slightly towards the apex, while that of the hypocone seems to have a slightly more marked slope. The shape of the lingual enamel of the occlusal surface is arc-shaped for both cones. On the anterior surface of the protocone the enamel shows a slight horizontal ridge (protostyle) but most of the surface is smooth by contact wear. The enamel of the hypocone ends abruptly at the posterior surface and this surface is hollowed

out and appears to be worn smooth by contact with the adjacent tooth. This appearance is not uncommon in giraffids.

Occlusal surface. The hollowed-out pits are irregular in shape, the enamel of the lingual and buccal lips of the pit being fairly separated. Because of the absence of parastyle, mesostyle and metastyle, it cannot be determined whether there are any separate islands of enamel in those regions which may have been linked to the central pit at an earlier stage of wear.

Roots. Most of the lingual root is present and it has a similar appearance to that previously described for 426 A and B.

C 426 D (plates 26(*c*); 28(*d*))

A left M^1 which is very incomplete, only a portion of the protocone remaining below a very fragmented lingual root. There is a small cingulum and a very slight thickening of the enamel just below the region of the cingulum where the tooth tends to bulge. The general shape and appearance of the protocone is identical to that of C 426 C.

F 39 (plate 27(*c*), (*d*), (*e*))

This is the type specimen of *Griquatherium haughtoni* Cooke 1949. It has been described as an isolated anterior pillar of a lower left molar, either M_2 or M_3 (*vide infra*). It is in an early stage of wear. Although the evidence for the viewpoint that this is half a lower molar is reasonable, peculiarly enough the specimen also presents a number of features which raise considerable doubt of the accuracy of this diagnosis and which could support the proposition that this specimen is an upper premolar. For this purpose it is necessary to compare it directly with Hopefield 4025 and Olduvai F 2989 (plates 45, 15–17). This matter is discussed in detail below, but the authors consider the evidence to be in favour of a left upper premolar and will describe the specimen on that basis as follows.

Buccal surface. The tooth is broken probably just below the crown-root junction, and a portion of the posterior aspect is broken away. The rugosity is fairly coarse. There is a marked rounded parastyle which is separated from the prominent median costa by a broad groove, and the costa in turn is separated from the prominent metastyle by a narrower groove. Near the occlusal surface, the metastyle swings posteriorly in an arc.

Lingual surface. It is coarsely rugose. The tooth is fractured at the crown-root junction and a small rolled cingulum can be seen at the base of the posterior lingual aspect. This appears to be sufficiently localized to warrant being called an entostyle. From the anterior aspect, it is obvious that the enamel of this surface presents a marked 'apron' effect. The lingual surface slopes markedly downwards in a buccal direction to a point approximately at the junction between middle and lower $\frac{1}{3}$ of the tooth. Then the surface tends to slope more vertically to the occlusal surface, so that the general effect is that the upper $\frac{2}{3}$ of the tooth has a marked lingual bulge. This lingual bulge is the most promi-

nent observed in the whole series of African Sivatheriinae. This matter will be more fully dealt with in the discussion, but it is here noted that an X-ray of the tooth (plate 27(*c*)) indicates internal vertical fracture lines, which may have been caused by intrusive compressing breccia. This may be an explanation for some of the excessive bulging observed.

Occlusal surface. The central pit is fairly wide and open posteriorly, while anteriorly the two enamel surfaces are in continuity with each other.

Posterior surface. A large piece of the enamel near the buccal aspect is broken away, especially from the upper $\frac{2}{3}$ of the tooth. But sufficient of the enamel is present near the occlusal surface to 'close' the lingual and buccal enamel crescents of the protocone. There is also sufficient enamel on the lingual surface to indicate that it is extending without interruption well towards the buccal aspect: this is further back than would be expected if the enamel were to be continued on to the contiguous surface of another pillar (on the alternative supposition that this may have been a lower molar). The enamel is heaped up slightly in the region of the protostyle.

Morphologically it may however be compared favourably with the anterior pillar of M_2 and M_3 of Olduvai 92 (BK II, 1952). On the other hand, if the probability of the dimensions of F 39 is calculated by the *t* test in respect of its being a M_2 or M_3, the following is obtained:

On the basis of	*Value of P* *F 39 = ? M_2*	*F 39 = ? M_3*
Occlusal length of anterior pillar ..	·05	·1
Maximum breadth of anterior pillar	·4	·3
Occlusal breadth of anterior pillar..	·8	·6
Buccal height of anterior pillar ..	·01	·01

Because of the large dimensions of this 'pillar' (on the alternative supposition that it is a lower molar), the available measurements have been utilized to reconstruct the whole tooth by a comparison with M_2 or M_3 of other known Sivatheriinae. Calculated on this basis, the Tr./A–P index of F 39 would be:

	M_2	*M_3*
F 39	64·1	46·1
Mean of Sivatheriinae ..	70·0	49·7

and the ratio $\frac{\textit{Occlusal length of anterior pillar}}{\textit{Maximum breadth of tooth}} \times 100$:

F 39	81·2
Mean of 12 Sivatheriinae M_2 ..	74·5
Mean of 10 Sivatheriinae M_3 ..	75·2

Consequently, it is reasonable to state that one cannot assign F 39 as a definite M_2 or M_3: it is furthermore clear that from the point of view of the length and breadth of the tooth (table 29), it is unlikely to be an anterior pillar of a lower molar. Its height is greater than that of any tooth in the available series (see also 'Discussion').

Sivatheriinae		*Anterior pillar: occlusal length*	*Maximum tooth length*	*Anterior pillar: maximum breadth*	*Maximum tooth breadth*
		mm.	*mm.*	*mm.*	*mm.*
M_2 (mean of 12 specimens)	..	26·0	51·2	34·9	35·7
M_3 (mean of 10 specimens)	..	25·0	68·6	33·3	33·6
F 39 Actual measurements	..	32·5		*c.* 40	
Inferred measurements:					
If M_2 ..	..		64·0		41·0
If M_3 ..	..		87·5		40·3

TABLE 29

B^1 and B^2

These two teeth are both from one site, probably Cornelia, but there are no records available concerning their discovery. The one tooth B^1 has three distinct roots, one lingual and two buccal, and is therefore an upper molar. In B^2 the roots are broken away and the tooth is only just commencing wear on proto- and paracone. It is also obvious that both teeth belong to the same jaw and the same side because of the exact fit of their contiguous surfaces. Because of, first, the small size of the root in B^1, secondly, of the hollowness of the root and the tooth, thirdly, of the thinness of the cement and enamel, and fourthly, of the general appearance of B^1 and B^2, it is considered that these teeth are deciduous. Consequently, B^1 is diagnosed a right DM^3 and B^2 is a right DM^4.

B^1 (plate 30(*a*), (*c*), (*e*))

Right DM^3. It is in early wear

Buccal surface. Small cingulum present. Rugosity very fine. Metastyle, mesostyle and parastyle have a very obvious rib-like effect, the parastyle being the largest of the three styles and being decisively rounded and separated from the lingual surface of the paracone by a distinct cleft. The ridge leading up to the apex of the paracone is more obvious than that leading up to the apex of the metacone, which is almost absent. The appearance is typical of the Family, the surface having an undulating effect, especially when seen from the lingual or the buccal aspect, the crests being formed by the apices of the paracone and protocone, and of the hypocone and the metacone, while the depressions are opposite parastyle, mesostyle and metastyle.

Lingual surface. The protocone has an obvious cingulum, while that of the hypocone is less obvious. On the antero-lingual aspect the enamel is heaped up and forms a ridge (protostyle). Similarly on the postero-lingual aspect of the hypocone, there is another ridge of enamel (hypostyle), but this is very small and less extensive than the protostyle. The surface is finely rugose. Just below each cingulum, there is a bulge which is less marked on the hypocone than on the protocone, and from this bulge the lingual surface slopes fairly acutely towards the apex. From the anterior and posterior aspects, the crown-root junction has an irregular line which is 'apron-like', as in the Hopefield upper teeth.

Occlusal surface. The protocone is quite separate from the hypocone but the central pits of the two pillars are continuous opposite the mesostyle, and it

can be seen that the separation of the pits would have been caused at a later stage of wear by the hypocone going to meet the paracone to form the metaconule. The lingual and buccal lips of the pits are widely separated, maximally at the centre of each pillar. The meeting of the protocone and the paracone takes place at the parastyle where their dentine and enamel surfaces are continuous. But the meeting of the hypocone and metacone is only by contact of their enamel surfaces.

Roots. The lingual root is rather small and oval-shaped, the separation into the two thickened portions of the root being hardly noticeable. The cement is very thin, the root and the tooth being completely hollow. The two buccal roots are thin and hollowed although the cement is thicker than in the lingual root; the posterior one is triangular and the anterior one is oval in shape.

B^2 (plate 30(*b*), (*d*), (*f*))

Right DM^4.

Buccal surface. There is a slight cingulum present on the hypocone and it leads up to a very marked mesostyle and a slightly less marked metastyle. The parastyle is prominent and rounded, and it has a small nodular excrescence on its buccal aspect. The mesostyle is somewhat split by a vertical furrow. The buccal aspect of the paracone is much more marked than that of the metacone The buccal surface of the metacone is distinctly spatulate-shaped as is commonly found in milk dentitions.

Lingual surface. Finely rugose. The hypocone has a slight bulging cingulum from which the lingual surface slopes rather sharply to the apex. Although the protocone is rather fragmented at its base, there seems to have been no cingulum, and the lingual surface also slopes rather sharply towards the apex. On the anterior surface, the enamel is thrown into a small ridge (protostyle) just above the crown-root junction.

Occlusal surface. The hypocone and metacone are just beginning to wear, whereas the protocone and paracone are worn to a more marked degree. All four cones are separated, their fusion only occurring between the hypocone and metacone near the metastyle, and between the protocone and paracone near the parastyle, while paracone and metacone are almost completely fused on the buccal surface medial to the mesostyle. Consequently, the central pits are 'wide open' although the two cones of each pillar have fused at the base of each pit at the base of the tooth.

Roots. No roots present. They have been broken off. The tooth is hollowed out.

Shape. The protocone is V-shaped and the hypocone is slightly more arched and broader. The paracone is almost a straight line while the metacone is spatulate-shaped.

CHAPTER 3

MAKAPANSGAT (NORTHERN TRANSVAAL, UNION OF SOUTH AFRICA)

The various discoveries in and the geology of the Limeworks Cave in the Makapan Valley have been fully described by Dart (1954), Oakley (1954b), Brain, van Riet Lowe and Dart (1955), Howell (1955), Brain (1957, 1958), and Wells and Cooke (1957) in whose publications further references may be obtained.

All the material described here is on loan from the Bernard Price Institute for Palaeontological Research (Johannesburg), and is derived from the Limeworks dumps wherein out of 1,862 skull remains already recovered some 30 belong to Giraffids (Dart, 1957). However one specimen, M 553 B^1, is from an unknown locality in the Makapan Valley, 'and probably from one of the limeworks' (Cooke and Wells, 1947). Some of the material is still heavily filled with calcified grey cave breccia.

The material received for study may be divided into two major groups: the first group consists of giraffid teeth referable to *Giraffa*, the determination of the species of which will be mentioned later. The second group is composed of fragments of the dentition and of the jaws of Sivatheriinae. Both groups were recovered from the same deposits, and from the nature of the breccia it is probable that they were contemporaneous in so far as the limits of the formation of the breccia are widely separated by a large period of time.

List of Material

A. GIRAFFA

(1) *Upper dentition*

(*a*) Milk	M 646	.. ..	right DM^2
	M 944	.. ..	left DM^2
	M 536	.. ..	left DM^3
	M 263	.. ..	fragment of right maxilla with DM^3-M^1
	M 533	.. ..	right DM^4
	M 535	.. ..	left DM^4
	M 1115	.. ..	left DM^4
(*b*) Adult	M 532	.. ..	left P^2
	M 531	.. ..	left P^3
	M 264	.. ..	right P^3
	M 1114	.. ..	right P^3
	M 552	.. ..	right M^1
	M 551	.. ..	left M^1
	M 550	.. ..	fragment of maxilla with left M^2
	M 528	.. ..	fragment of maxilla with left M^2-M^3

(2) *Lower dentition*

(*a*) Milk	M 939	.. ..	fragment of left mandible, with DM_2 and DM_3
	M 540	.. ..	fragment of right mandible, with DM_2-DM_4
(*b*) Adult	M 936	.. ..	right M_2
	M 942 and M 1113		joined fragments of right M_2
	M 938	.. ..	fragment of right mandible with M_3

B. SIVATHERIINAE

(1) *Upper dentition*			
Milk	M 937	.. ..	isolated left DM^3 or DM^4
	M 524	.. ..	right, probably DM^3
	M 941	.. ..	right, DM^3 or DM^4
(2) *Lower dentition*			
(*a*) Milk	M 525	.. ..	left DM_3
	M 539 B	.. ..	fragment of right mandible with DM_4
(*b*) Adult	M 527	.. ..	incisor
	M 1116	.. ..	incisor
	M 553 A	.. ..	fragment of left mandible with P_2
	M 553 B	.. ..	fragment of right mandible with P_2—P_3
	M 553 B[1]	.. ..	fragment of left mandible with M_1—M_2
	M 943	.. ..	isolated pillar of right M_2
	(See also Appendix.)		

Description

A. Giraffa

The general appearance of these teeth is the same as that of the extant *Giraffa camelopardalis* and nothing can be gained by describing each specimen in detail. The only variations that may be noted are minor individual ones, namely, those of irregularity of enamel ridges present in some and not in others, the presence of entostyle and parastyle, of ectostylid and parastylid and other variations which are also found in the non-fossilized extant material.

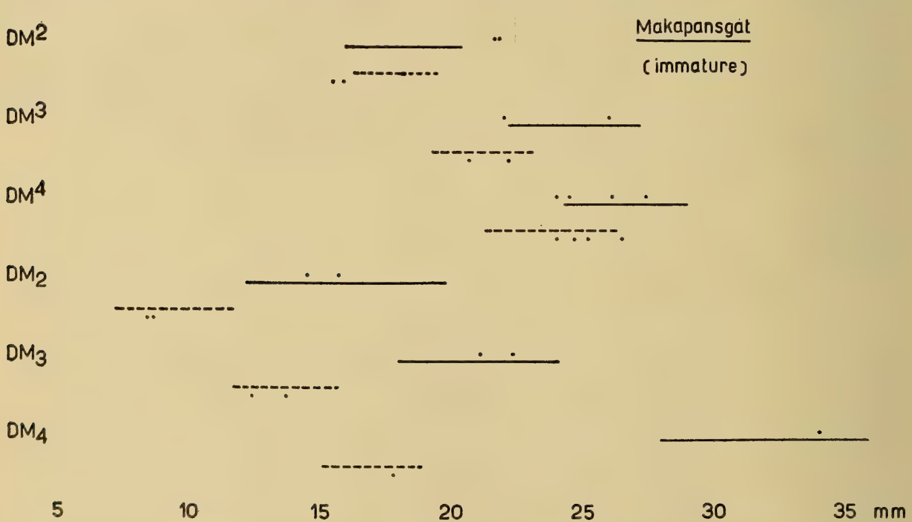

FIG. 19. Dimensions of deciduous teeth of Makapansgat *Giraffa* plotted against ranges of variation in modern *Giraffa camelopardalis*.
—— = A–P length. ------ = Transverse (breadth). . = Makapansgat specimens.

(1) UPPER DENTITION

(*a*) *Milk teeth*

M 646 *and* **M 944** (plate 31(*a*), (*i*), (*q*); 31 (*b*), (*j*), (*r*))

These are deciduous upper second molars, 944 being left and 646 being

right. They are in the same stage of early wear and are identical to each other. It is considered that they probably belong to the jaw of the same individual.

M 536 (plate 31(*c*), (*k*), (*s*))

An isolated left upper deciduous third molar, the posterior buccal root of which is broken off at the base, while the other roots are broken about half-way down. The tooth is in fairly advanced wear.

M 263 (plates 32(*g*); 33(*d*); 34(*d*))

This is a fragment of the right upper jaw containing DM^3, DM^4 and M^1. The teeth are in early stage of wear, DM^3 being in a more advanced stage than M^1 whose posterior part of the posterior pillar is just commencing wear.

In spite of their similar appearance and their similar degree of wear, it is unlikely that 944 and 536 (left DM^2 and DM^3 respectively) on the one hand, and 646 and 263 (right DM^2 and DM^3 respectively) on the other hand belong to a single individual. The Dental Index has been calculated (see Section I, chapter 5) for both pairs of teeth, and compared with the corresponding range of variation for the extant *G. camelopardalis*. As seen in the following table, all three ratios (length, breadth and Tr./A–P index ratio) fall outside the respective ranges for the extant material:

	Dental index		*Tr./A–P*
	Length index	*Breadth index*	*index*
944/536	83·3	71·7	85·7
646/263	99·0	74·8	75·7
Range of DM^2/DM^3 in *G. camelopardalis*	62·7–81·9	75·5–92·3	94·0–127·4

TABLE 30

M 533 (plate 31(*d*), (*l*), (*t*))

It is an isolated right upper deciduous fourth molar, with the roots broken off at the base. The anterior pillar has just commenced wear.

M 535 (plate 31(*e*), (*m*), (*u*))

It is an isolated left upper deciduous fourth molar, with the anterior buccal root broken off at the base, while the two other roots are broken about half-way down.

M 1115 (plate 31(*f*), (*n*), (*v*)

It is an isolated left upper deciduous fourth molar, whose roots are broken off near the base. It is in an early stage of wear.

(*b*) *Adult teeth*

M 532 (plates 33(*f*); 35(*a*), (*e*))

This is a left upper premolar, P^2, in early wear.

Buccal surface. It has the typical appearance of a paracone of an upper premolar. Although there is a vertical furrow on the buccal surface between

paracone and metacone, there is no separation on their lingual surface. Between the apex of the paracone and the parastyle, there is a small enamel tubercle. The central pit is irregularly V-shaped being open anteriorly, but closed by a ridge of enamel posteriorly between the protocone and the metacone, while the enamel in the region of the protocone invaginates into the central pit as a double fold.

Lingual surface. The surface is fairly rugose. There is a ridge of enamel opposite the centre of the protocone, while this ridge increases posteriorly to form a broad entostyle.

M 531 (plates 33(*h*); 35(*d*), (*h*))

A left P³. This is a very worn tooth.

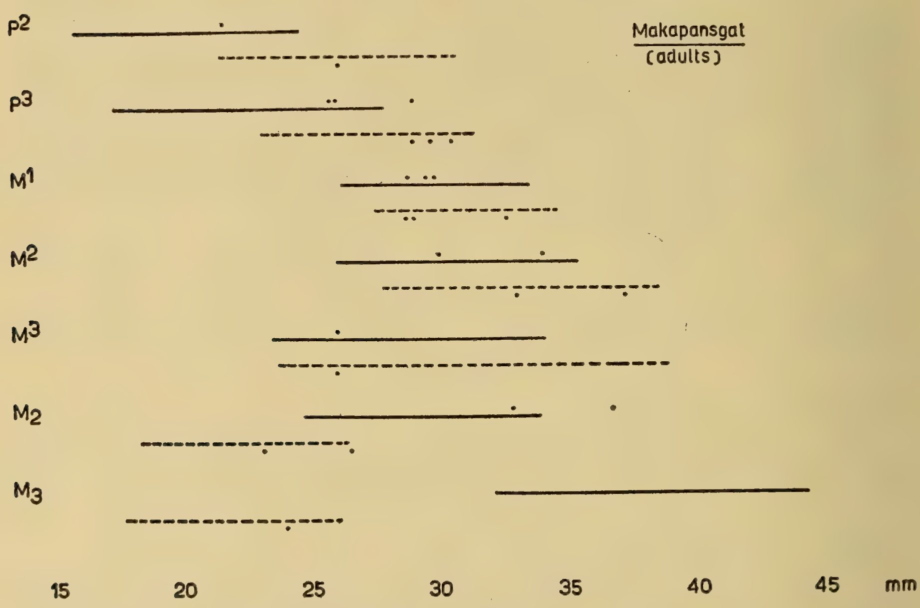

FIG. 20. Dimensions of adult teeth of Makapansgat *Giraffa* plotted against ranges of variation in modern *Giraffa camelopardalis*.
—— = A–P length. ------ = Transverse (breadth). . = Makapansgat specimens.

Lingual surface. A cingulum is present; rugose lines may be seen scattered all over the enamel, but the surface has been smoothed. The enamel bulges just below the cingulum and there are marked bulges at the bases of the parastyle and the metastyle.

Occlusal surface. The central pit is almost obliterated, the enamel of the two sides being in close contact or even fused, and there is a small island of enamel cut off from the central pit in the direction of the metastyle.

The *roots* are very similar in shape to M 1114 (*vide infra*), but they are ever shorter, their tips tapering to a sharp point very rapidly.

M 264 (plates 33(*i*); 35(*b*), (*f*))

A right P^3, which is in very advanced wear. The general appearance is that of M 531, except that the rugosity is more widespread and that the small island of enamel on the occlusal surface which leads up to the metastyle is in contact with the enamel of the rest of the central pit. The parastyle is markedly curved and twisted posteriorly on its own axis, as in M 531 and M 1114. As in M 531 too, the entostyle is not present because the tooth is worn above the level at which it projects in M 1114 (*vide infra*).

Roots. They are rather smaller than in other teeth and there appears to be a constriction at the base of the posterior buccal root.

M 1114 (plates 33(*g*); 35(*c*), (*g*))

A right upper ? third premolar, fragmented and in advanced wear, with the metacone broken off.

Lingual surface. A cingulum is detectable and there is a rounded bulge below it. There is a minute enamel nodule on the antero-lingual aspect in the region of the protostyle. It is fairly rugose. There is a marked entostyle on the posterior part of the lingual surface. Half the buccal surface is missing. The anterior half resembles the paracone of a premolar in that the enamel ridge passing to the apex is thick, rounded and triangular in shape and the enamel is folded to form a prominent parastyle. The central pit is irregularly V-shaped. It narrows towards the parastyle, but broadens out towards the metastyle where the enamel is partly broken away. As mentioned in M 264, M 531 and M 532, the buccal enamel of the protocone evaginates into the central pit and with wear it isolates (M 531, M 264) an island of enamel of the central pit in the region of the metastyle. This feature is common to the premolars in *Giraffa* and Sivatheriinae.

Roots. There are three roots. The lingual root is very broad at the base, triangular in shape, and the two buccal roots are smaller and separated by a V-shaped interval from each other and from the lingual root. The roots are all short. The two buccal roots are broken off half-way.

M 552 (plate 31(*g*), (*o*), (*w*))

An incomplete, isolated right M^1; the roots are broken off at the base. The tooth is in quite early wear.

M 551 (plate 31(*h*), (*p*), (*x*))

It is an isolated left upper molar, M^1, with the roots broken off at the base. Very slight degree of wear can be observed only on the anterior cones of the anterior pillar.

M 550 (plate 34(*f*))

This is a fragment of a maxilla containing a left M^2, while the sockets of the roots of M^1–P^3 are visible. The tooth is very worn especially on the posterior

aspect of the posterior pillar where the enamel has disappeared completely. The dentine on the occlusal surface has been hollowed by an unusual type of wear. The maxilla is rather squashed and the empty root sockets are filled with calcite matrix. On the upper aspect of the specimen a portion of the maxillary sinus has remained.

M 528 plates 32(*h*), 33(*e*), 34(*e*))

This is a fragment of maxilla containing left M^2 and M^3 which are in an advanced stage of wear.

(2) LOWER DENTITION

(*a*) *Milk teeth*

M 939 (plate 37(*a*), (*h*), (*k*))

A fragment of a left mandible containing DM_2 and DM_3, and part of the socket of DM_4 is present.

M 540 (plate 37(*b*), (*g*), (*i*))

A fragment of a right mandible containing DM_2–DM_4.

Measurements of mandible opposite talonid of DM_4 (*mm.*)

Lingual height	40·2
Buccal height	36·3
Thickness	27·0

(*b*) *Adult teeth*

M 936 (plates 32(*e*); 33(*b*); 34(*c*))

A fragmented lower right molar, probably M_2.

M 942 (plates 32(*f*); 33(*c*); 34(*b*))

It is the posterior pillar of a right lower second molar.

M 1113 (plates 32(*f*); 33(*c*); 34(*b*))

It is the anterior pillar of a right lower second molar. It and M 942 have identical contact surfaces and fit each other, forming a single tooth.

M 938 (plates 32(*d*); 33(*a*); 34(*a*))

It is a fragment of a mandible containing an erupting M_3 and there is also a socket for the posterior buccal side of the root of a M_2: the posterior root of M 942 fits perfectly into this socket, and it is obvious that M 938 and M 942–M 1113 belong to the same individual.

Determination of the Species of the Makapan Giraffa

It has already been stated (see introduction to the description, chapter 3) that morphologically (non-metrically) these fossil specimens are indistinguish-

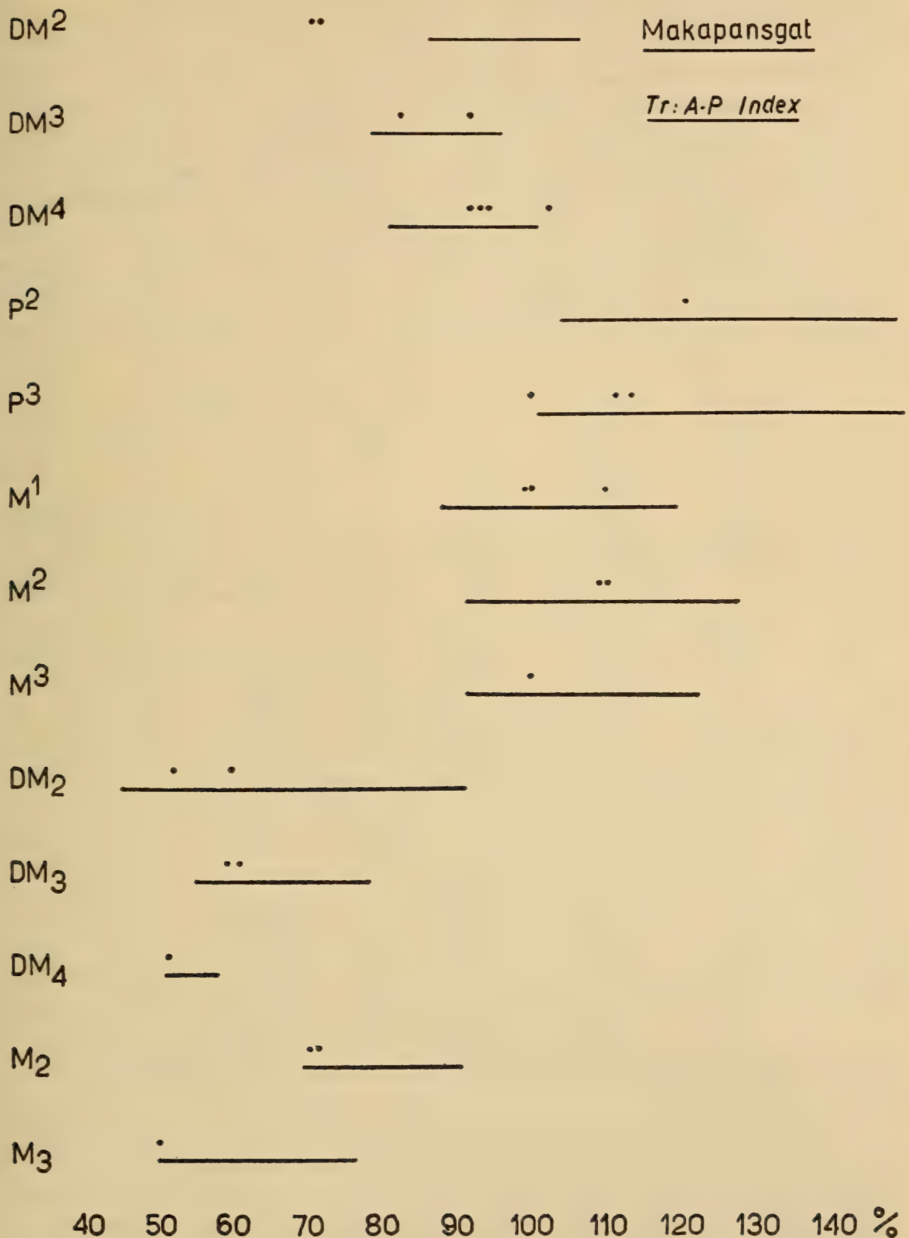

FIG. 21. Transverse/A–P Index of Makapansgat *Giraffa* plotted against ranges of variation in modern *Giraffa camelopardalis*.
● = Makapansgat specimens.

able from the extant *Giraffa camelopardalis*. Statistical analysis of the dimensions of the specimens indicates that in general they fall well within the range of variation of *Giraffa camelopardalis* (figs. 19, 20, 21, table 39). However, it must be pointed out that in quite a number of cases, the dimensions tend to fall towards the lower limit of and even just outside the extant range; while in some cases, they fall beyond the upper end of this range (for instance, length and breadth of M 646, M 944; lengths of M 938, M 942 and M 1113). This distribution raises the possibility that the specimens may belong to another species or subspecies.

Consequently the *t* test was applied to both the A–P and transverse dimensions of each of the specimens. The results of this analysis are given in table 31. It will be seen that the probability (P), i.e. of belonging to *G. camelopardalis*, is less than ·01 (1%) in only five cases.

Tooth	*Specimen*	*A–P* *t-value*	*A–P* *P smaller than*	*Transverse* *t-value*	*Transverse* *P smaller than*
DM^2	M 646, M 994	3·2156	·01	2·1258	·05
DM^3	M 263, M 536	·5027	·7	·2974	·8
DM^4	M 533, M 263, M 1115, M 535	1·358	·2	1·354	·2
DM_2	M 939, M 540	·2663	·8	1·464	·2
DM_3	M 939, M 540	·9029	·4	·9443	·4
DM_4	M 540	·6874	·5	·6801	·5
P^2	M 532	·3984	·7	·2550	·8
P^3	M 1114, M 264, M 531	4·5118	·01	1·5456	·2
M^1	M 263, M 552, M 551	·58	·6	·791	·5
M^2	M 550, M 528	·1772	·9	2·3455	·02
M^3	M 528	1·9095	·1	2·846	·01
M_2	M 936, M 942, M 1113	3·069	·01	1·074	·3
M_3	M 938	1·6454	·01	·3409	·8

TABLE 31. Results of application of the *t* test to the length and breadth measurements of the teeth of *Giraffa* from Makapansgat. (P = probability)

A further step was to estimate the extent to which these 'abnormal' dimensions occur together in a single population. Because of a probable correlation between transverse and A–P measurements in individual teeth, the probability should only be considered for one or the other measurement, and consequently it has been estimated separately for each dimension. In respect of the A–P dimension, applying the binomial distribution, the probability that in 13 cases, 4 measurements occur on a less than ·01 chance is ·09, which is not highly significant. It is obvious that P, estimated on the basis of

the transverse dimension, is still less significant. Therefore there is no basis for placing these specimens in a different species from *G. camelopardalis*.

Furthermore, because the Makapansgat teeth are mainly isolated specimens and the measurements of the majority of the modern specimens were taken on intact jaws, slight differences in the actual measurements probably resulted. This would sufficiently account for the few isolated exceptional results. However it has also been established in other groups of the Hopefield fauna that the Pleistocene fossil representatives of modern species tend to have dimensions (of teeth and skeletal parts) towards the upper end of or just outside ranges of variation of the modern species (Ewer and Singer, 1956; Hooijer and Singer, 1960).

B. Sivatheriinae

UPPER DENTITION

Milk

M 937 *and* **M 524**

For the same reasons as given for Cornelia B^1 and B^2, these two teeth are deciduous molars.

(*a*) **M 937** (plate 37(*c*), (*e*), (*j*))

It is either an upper left DM^3 or DM^4. It is unworn.

Buccal surface. There is a cingulum on each of the cones which have a typical spatulated appearance, the paracone being less curved than the metacone. The general appearance is similar to the buccal surface of B^2 from Cornelia, except that the central ridges leading up to the apex of the paracone and of the metacone are much more prominent. The parastyle is broken off.

Lingual surface. The crown-root junction is fragmented, but a cingulum appears to have been present adjacent to this area, and there is a rounded bulge below the cingulum. The enamel is fairly rugose and is thrown into horizontal ridges on the anterior surface of the anterior cone. The lingual surface of the protocone has a thickened pilastering which leads up to the apex. This effect is slightly less marked on the hypocone.

Occlusal surface. The hypocone has a V-shape, while the paracone tends to be slightly more U-shaped. The central pits are open in the region of the mesostyle.

Roots. The lingual root is broken off at the crown-root junction while the other two roots are embedded in a fragment of the maxilla and matrix.

(*b*) **M 524** (plate 37(*d*), (*f*), (*l*))

A right ? DM^3.

Buccal surface. There is a rounded cingulum. The metacone presents a typical spatulated surface, with the mesostyle curving outwards and forwards.

The paracone has a marked central costa which is very broad at the base and which has two vertical furrows near the apex. The parastyle is prominent with a thick rounded base. There are small nodular excrescences on the parastyle which tends to recurve near the apex to give the cone its spatulated shape.

Lingual surface. It is finely rugose. There is a rounded cingulum which is more marked on the protocone and which has a small denticulated ridge of enamel below it. There is a very marked protostyle on the anterior surface. On the posterior surface of the hypocone, the enamel ridge is much less marked and there is no cingulum on this surface. There is a small linear entostyle present.

Occlusal surface. The central pits are wide and open, except in the region of the parastyle where the anterior part of the protocone fuses with the paracone. The hypocone is V-shaped while the protocone is flattened out.

Degree of wear. The anterior pillar and the anterior part of the posterior pillar are slightly worn while the posterior part of the posterior pillar is just beginning to show signs of wear.

M 941

This is either a right DM^3 or DM^4. The roots are broken away, and on the crown only the hypocone is more or less intact. It is in early wear. This tooth shows similar characteristics to those seen on M 937. The lingual surface slopes at a fairly marked angle towards the apex. The buccal surface also slopes but to a lesser degree.

LOWER DENTITION

(*a*) *Milk teeth*

M 525 (plate 32(*a*), (*b*), (*c*))

This is a deciduous tooth and probably a left DM_3 (see Dental Index of M 525/M 539 B (DM_4), *vide infra*). There is a small rounded cingulum which is particularly prominent on the hypoconid. The surface of the tooth is finely rugose and worn; there is a rather large bulge on the cingulum on the posterior aspect of the hypoconid. There is no cingulum in the region of the entostylid where the hypoconid fuses with the entoconid.

Buccal surface. There is a fine groove between the hypoconid and the protoconid. The protoconid has a distinct bulge. Posteriorly the protoconid is fused with the enamel of the entoconid, and the metaconid juts out on the lingual aspect of this fused ridge. Anteriorly, the protoconid is continuous with the parastylid which also juts out at right angles from the enamel ridge, and this, in turn, fuses the protoconid with the parastylid. Consequently, there is a V-shaped depression between parastylid and paraconid on the lingual aspect of the tooth, although the two are fused on the lingual surface about half-way from the occlusal edge of the tooth. There is also a U-shaped depression on the lingual side of the protoconid between the projections of paraconid

and metaconid, which are fused to each other about two-thirds of the way down from the occlusal edge of the tooth, so that there is a V-shaped interval between them on the lingual surface. There is a small depression between metaconid and entoconid near the occlusal edge. A linear central pit stretches between the hypoconid and the enamel ridge, which links entostylid–to–entoconid–to–protoconid.

There is a small cingulum on the *lingual surface*. There are two hollow *roots*, a posterior one below the hypoconid and an anterior root below the protoconid. A distinct similarity is observed between this tooth and P_3 of M 553 B. The only differences in appearance being that the metaconid projects in a more lingual direction in M 525, and that the enamel ridge forming the central pit of the paraconid in M 553 B is circular, while in M 525 it is more V-shaped, and that the occlusal edge of the lingual surface is not as high in M 525.

M 539 B (plate 38)

This is a fragment of a right mandible containing a DM_4 which has just erupted, and the tip of paracone of M_1 is visible because the surrounding alveolus is broken away.

Buccal surface. The enamel of DM_4 is fairly rugose. There appears to have been a cingulum and there is a large hypostylid and a broken-off ectostylid.

Lingual surface. There is a rounded cingulum. Finely rugose. On the paraconid there is a broad, flattened central costa leading up to the apex of the pillar, while the parastylid and mesostylid are less marked; the parastylid curves slightly inwards at its anterior extremity, so that the surface presents a slightly spatulate appearance. The metaconid has a similar appearance, but anteriorly it fuses with the mesostylid of the anterior cone. The lingual surface of the anterior pillar overlaps that of the posterior pillar which in turn overlaps that of the talonid. The talonid has a very marked central costa leading up to its apex from the cingulum. This pillar is particularly broad at its base so that it appears to occupy most of the surface. The anterior portion of the surface curves slightly inwards, and comes to lie against the metastylid of the posterior cone.

Occlusal surface. The A–P axis of the lingual surface of the posterior cone is at a slight angle to that of the talonid; the anterior portion of this cone is angulated at an even greater angle to that of the posterior cone. The central pits are wide and open, and on the buccal surface of the paraconid the enamel is markedly ridged, so that it projects backwards into the central pit. The buccal cones are V-shaped in occlusal view, the central portion of each surface producing a ridged effect which leads up to the apex of each cone.

Roots. Through the broken mandible the top of the short central root is visible. On X-ray (plate 38(*c*)) the outline of the developing tooth bud of P_4 may be seen, as well as the outline of the alveolar 'pocket' containing M_1 which is still embedded in the mandible.

Measurements of mandible (mm.)

Breadth opposite the talonid ..	32·0
Breadth opposite M_1	34·0
Height opposite the talonid ..	*c.* 47

The Dental Index (see Section I, chapter 5) has been calculated between left DM_3 (M 525) and right DM_4 (M 539 B), in order to determine whether they belong to the same jaw. All three ratios fall well within the range of variation of the corresponding index for the corresponding measurements in extant *G. camelopardalis* and are very close to their mean values.

	Length index	*Breadth index*	*Tr./A–P index*
M 525 / M 539 B ..	60·0	75·6	124·0
G. camelopardalis:			
Mean	63·1	79·7	123·5
Range	55·6–72·3	70·2–92·1	98·7–144

TABLE 32

(*b*) *Adult teeth*

M 1116 *and* **M 527**

These are two incisors in very early wear; M 527 is at a slightly earlier stage than M 1116. Judging by the slope of the anterior edge of the enamel of the teeth, it would appear that M 1116 belongs to the left side and M 527 is right.

M 1116 (plate 36(*d*), (*e*), (*f*))

Buccal surface. The enamel is finely rugose and there is a distinct cingulum which bulges out on the lingual and the buccal aspect. However, the cingulum is absent on the sides of the tooth. In buccal view, the tooth is rather V-shaped, but the apex of the V (i.e. at the crown-root junction) is flattened, while the upper edges of the V are slightly flanged outwards. The outer surface is convex in a mesio-distal plane.

Lingual surface. The anterior edge of the enamel is spade-shaped, while the posterior edge is irregular (‾|_|‾). The dentine is hollowed out, the edges of the dentine sloping towards a deep central portion; it is slightly worn at its anterior end.

Roots. The root is almost complete and rather oval in shape, being slightly flattened anteriorly, resembling very much the root of Hopefield 4026. Viewed from the side, the crown-root junction has an inverted V-shape.

M 527 (plate 36(*a*), (*b*), (*c*))

This appears to be a right incisor, identical in appearance and shape to M 1116, but being a little broader from side to side and in a mesio-lingual plane at the crown-root junction.

Measurements (*mm.*)	*M 1116*	*M 527*
Total height	*c.* 74	—
Crown (buccal) height	37·4	38·4
Length	22·0	22·7
Maximum height (just above the crown-root junction, i.e. at its highest point)	17·6	17·4

TABLE 33

M 553 A (plates 39(*a*), (*b*); 40)

This is a fragment of a left mandible on which the posterior part of the symphysis menti is present. It contains a P_2 about to erupt as well as the tip of the root and I_1 and the breccia-filled sockets for the tips of I_2 and I_3. There is no evidence of the canine. On the outer aspect, near the front of the fragment, a large foramen mentale is present; it is oval in shape, with rounded edges, and leading from it anteriorly there is a deep groove.

The tip of the canine is approximately opposite the mental foramen which in turn is opposite the posterior end of the symphysis.

The superior border of the fragment is very sharp, while the inferior border is rounded. The medial surface is smooth and convex in shape, while on the outer surface, there is a deep horizontal furrow about one-third of the height below the superior border. The symphysial region is markedly irregular and its posterior end is oval in shape and flattened from above downwards.

P_2

Although partially embedded in the mandible, most of the crown is visible for description.

Buccal surface. Fairly rugose. The crown-root junction is not visible and a cingulum formation cannot be commented on. But the hypoconid is rounded and bulging above the crown-root junction, and slopes gradually towards the apex. It is split vertically by a deep groove which extends down half-way from the occlusal surface.

On the *posterior surface* there is a thickened ridge of enamel, at the lingual end of which the medial portion of the entostylid is broken off.

Lingual surface. This is also fairly rugose, and its prominent feature is the metaconid which bulges out on the surface so that there is a hollow between it and the entoconid. But anteriorly there is only a slight depression between the metaconid and the paraconid; the parastylid is not visible.

Occlusal surface of this unworn tooth is irregular in shape, the highest point being the apex of the protoconid which is still fused with that of the metaconid.

The absent canine is broken off near the tip of the root. All that one can see is its circular shape. It almost occupies the whole breadth of the bone in this region; it is 19 mm. in diameter.

Height opposite anterior end of P_2 (buccal side)	67·7
Height opposite mental foramen	67·2
Maximum thickness opposite P_2	26·5
Distance (direct) between anterior edge of alveolus of P_2 and posterior edge of mental foramen	99·0
Distance between anterior edge of alveolus of P_2 and posterior border of symphysis	102·5

TABLE 34. Measurements of mandible (mm.).

M 553 B (plate 39(*c*), (*d*))

This is a fragment of the right half of a mandible containing P_2 and P_3, and showing a part of the alveolar fossa for P_4. Beyond P_2 the sharp anterior border continues for about 7 cm. to the broken end where there is a vertical fracture. On the buccal aspect of the mandible there is a broad and deep groove which almost disappears opposite P_4: here the buccal surface tends to be almost straight in a vertical direction. The lingual surface is convex and the inferior border is rounded, as in M 553 A.

P_2

It is just erupting and partly broken. Part of its alveolar socket is broken away, so that one can ascertain that it is similar in appearance to P_2 of M 553 A.

P_3

It is still embedded in its bony alveolar socket and only its tip is erupting. Most of the lingual surface of the alveolus is broken off, so that a large part of the crown is visible for study. The *buccal surface* is fairly rugose, while the lingual surface is slightly smoother.

The highest point of the tooth is the protoconid which is shaped like an inverted V, and this cone occupies most of the buccal surface of the tooth. The hypoconid is small and in continuity with the protoconid. Half of the lingual surface is occupied by the entoconid and metaconid, the metaconid being almost at a right angle to the lingual aspect of the protoconid and is fused with it just posterior to the protoconid apex: in this way an irregular L-shaped central pit is formed. Between the metaconid and the paraconid there is a wide interval, the two being joined laterally by a part of the lingual aspect of the protoconid. The metaconid meets the paraconid just above the crown-root junction so that, viewed from the lingual aspect, there is a V-shaped interval between them. The paraconid is angulated at right angles to the A–P axis of the body of the protoconid, while the anterior part of the protoconid is also angulated at right angles to the rest (body) of its own axis. Thus an oval-shaped pit is formed between the protoconid and the parastylid. On the lingual surface, the parastylid is seen as a prominent bulge, the apex of which is at the occlusal junction between the recurved paraconid and the protoconid.

Maximum breadth opposite P_3	35·0
Maximum breadth opposite P_2	27·0
Height opposite anterior end P_2 (buccal side) . .	67·3
Height opposite anterior end P_3 (buccal side) . .	77·4

TABLE 35. Measurements of mandible (mm.).

M 553 B¹ (plate 41)

This specimen was described by Cooke and Wells (1947) as *Griquatherium cingulatum* neotype.

It is a fragment of a left mandible containing M_2 and M_1. Posterior to M_2, where M_3 would have been, there is a mass of limestone matrix. Anterior

to M_1 the posterior cones of P_4 are just erupting through the alveolar surface, and there is a vertical fracture through the anterior cones, indicating the early stage of eruption of P_4. On X-ray, the socket for the anterior root of M_3 is seen filled with breccia. The roots of the other teeth are very long, penetrating more than two-thirds of the height of the body of the mandible. The crown-root junction is well below the alveolar margin.

M_2

The tooth is in early wear, and hypsodont in appearance. It slopes slightly anteriorly from below upwards. The buccal surface is fairly rugose and there is no cingulum formation visible. The enamel has slight irregularities on it, and there is a small protostylid. Looking at the posterior surface, it can be seen that the buccal surface has quite a marked slope towards the apex, and that, in similar fashion, the lingual surface has an even more marked slope, especially in the region of the entoconid.

Lingual surface. The crown-root junction is not visible, but there appears to be no, or very little, cingulum formation. The surface is fairly rugose. The rugose lines of the enamel tend to radiate upwards from the crown-root junction and forwards and backwards from the central costa in a fan-shaped fashion. The entostylid is broken off, and the anterior portion of the entoconid is in contiguity with the metastylid at the occlusal surface, but the enamel on their lingual surfaces tends to fuse lower down. The metastylid is partly broken off but it is fairly marked, while the parastylid is short and blade-like, and it is sharply angulated anteriorly. The central costa passing from the crown-root junction to the apex of the metaconid is much thicker and more marked than that of the entoconid.

Occlusal surface. The four cones are almost completely separated from each other. The protoconid is contiguous with the paraconid at the apex of the parastylid, while the hypoconid meets the entoconid in the region of the entostylid. But the central pits are not completely closed off where the anterior pair of cones meets the posterior pair of cones, and the medial and lateral lips of the central pits are rather widely separated. At this early stage of wear, the dentine appears as a narrow strip in each cone, and the protoconid and the hypoconid are V-shaped, while the metaconid and the entoconid tend to be more flattened.

M_1

It is in a slightly more advanced stage of wear than M_2, and has the identical appearance of M_2, except that the dentine is thicker in each cone.

Height opposite anterior pillar M_1 (lingual aspect)	..	78·5
Height opposite anterior pillar M_1 (buccal aspect)	..	75·0
Breadth opposite anterior pillar M_1 (maximum) ..	..	49·7
Breadth opposite anterior pillar M_2 (maximum) ..	..	55·5

TABLE 36. Measurements of mandible M 553 B[1] (mm.).

Note.—M 553 A and M 553 B must belong to opposite sides of the same lower jaw, because of:

(1) the proximity of the discovery;
(2) the same dental age, judging by the stage of eruption; and
(3) the similar size and shape of corresponding regions of their fragments and of their teeth (P_2).

That portion of M 553 B which we consider to correspond to the posterior portion of A has been reconstructed (fig. 22). It appears obvious that M 553 A must belong to M 553 B^1; this is in accordance with the degree of eruption of P_4 and the degree of wear of M_1 and M_2 in the latter fragment. Consequently these three fragments must belong to the same individual. (See also 'Appendix'.)

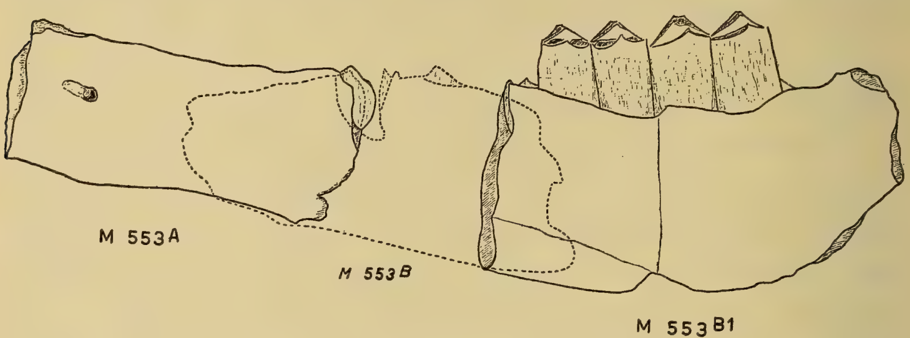

FIG. 22. Reconstructed mandible of the Makapansgat *Sivatherium olduvaiense*.

M 943

This is a fragmented posterior pillar of a right M_2. It has all the features of the corresponding pillar of M_2 of M 553 B^1, but it shows more clearly the groove separating the hypoconid and the entoconid on the posterior surface, just above the point where they fuse. The degree of wear and the general features are so similar to the above corresponding specimen that they could almost be considered to belong to the same jaw.

The lingual surface has a large piece of enamel broken off; the whole of the buccal surface may be measured because the tooth is not embedded in its jaw (table 40).

CHAPTER 4

HOPEFIELD (CAPE PROVINCE, UNION OF SOUTH AFRICA)

The description of the geological features of the fossiliferous site on the farm 'Elandsfontein', near Hopefield, 60 miles north-west of Cape Town (fig. 23) has been recorded previously (Drennan, 1954; Singer, 1954; Mabbutt, 1956). All the material, referred to as 'the Hopefield specimens' have been recovered from the site and are now housed in the S.A. Museum.

No stratification has been found on the site which consists of approximately 2 square miles (5 km.^{2}). 'The site lies in the sand veld between the Sout River and the Langebaan-Saldanha Lagoon. This site is 300 feet above sea-level and is divided into wind-scoured kloofs or depressions by sand-dunes which are either drifting or, where covered by vegetation, stationary. Ridges of

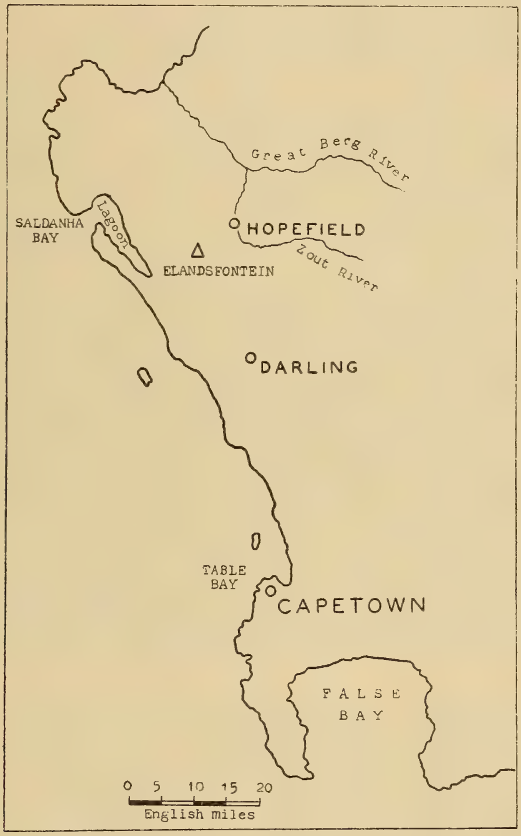

FIG. 23. Map indicating the Elandsfontein fossil site, near Hopefield.

ferricrete cut diagonally across the length of the site, and in places the dunes are capped by massive calcrete mounds or flat boulders of partly silicified surface limestone. Softer, cellular calcretes are found in certain places at the lowest parts of the depressions. The tortuous courses of the ferricrete ridges indicate that they are the indurated lower flanks of old sand-dunes* now

* Recent research by Mr. D. Needham, University of Cape Town, tends to contradict that there were sand-dunes, in the geological sense, originally present. Convincing evidence indicates that the modern 'dunes' are the result of a recent 'heaping-up' of the tertiary marine-deposited sands.

stripped bare of the sand walls. This ferruginization is usually associated with moist ground conditions, a fairly high stable water-table and an abundance of vegetable acids in the soil. It seems that this fossil site was at one time a large vlei or lagoon along the edge of which animals roamed.' (Singer and Keen, 1955).

The movement of the present sand-dunes uncover the calcareous floors from which the fossils and artefacts are recovered.

The majority of the giraffid teeth as well as the cranial fragments have been recovered from different localities on the 'Main site'. However, fragments 4029, 4029 A, 4029 B and 4374 were discovered on a ferricrete deposit in site E–extension (Tex. 1). Further tooth fragments (4030, 4030 A and 4031) were found on and near a ferruginous plateau in 'Buffalo Bay', less than 50 yards from E–extension, but separated from it by a large sand-dune, and it is quite likely that the ferricretes of the two localities are in continuity through the sand-dune.

As a matte of interest, specimens 4029 (heavily encrusted with ferricrete) and specimen 4028 A (found on a calcareous floor and only slightly ferruginized) were X-rayed together at a distance of 3 feet with 115 kv. for 2 seconds. The skiagram showed that 4029 was far denser than 4028 A, which possibly signifies that it may be more heavily fossilized. The disparity in the skiagrams is also reflected in the Uranium (U_3O_8) content (by courtesy of Dr. K. P. Oakley, British Museum of Natural History), that of 4028 being 14 ± 2 p.p.m. and that of 4029 being 4 ± 2 p.p.m. This indicates that the latter may have come from a higher level, and that conditions for fossilization may have been more favourable. The fluorine contents (by courtesy of Mr. H. E. Krumm of African Metals Corporation, Bellville, Cape) are 1·983% and 1·663% respectively, and the nitrogen contents are 0·11 and 0·085 respectively.

List of Material

		Hopefield No.	*S.A. Museum No.*	
A. GIRAFFA		3345	11716	right P^2
B. SIVATHERIINAE				
(1) *Cranial fragments*		4372 B	11717	base of a skull
		4372	11717	posterior horn-core
		4372 A	11717	fragments belonging to 4372
		4373	11718	posterior horn-core
		4373 A	11718	anterior horn-core
		4373 B, C	11718	fragments belonging to 4373
(2) *Teeth*				
	Upper	4025	11719	right P^3
		4027	11720	right M^1
		4023	11721	left M^2
		4024	11722	left M^3
	Lower	4026	11723	incisor
		4374	11724	left M_1 or M_2
		4028–4028 A	11725	fragment of left mandible with M_2-M_3
		4029–4029 B	11726	fragment of left mandible with M_1-M_3
		4030	11727	right M_2
		4031	11728	right M_3
		4030 A	11727	fragments of roots and pillars

Description

A. Giraffa

3345 (plate 45(*c*), (*d*), (*h*))

This is a right P^2. The tooth is in late wear.

Buccal surface. There is a well-defined cingulum. The surface has a 'W' formation with marked parastyle and metastyle as well as a marked paracone. Between the latter and the two styles there are deep grooves. In anterior or posterior view, the lingual and buccal surfaces slope towards each other in the direction of the apex.

Lingual surface. The enamel is finely rugose and there is a well-marked cingulum. The lingual surface slopes sharply from the cingulum towards the apex in a buccal direction. There is a smooth surface on the posterior aspect of the tooth indicating contact with P^3.

Occlusal surface. The enamel of the paracone is arc-shaped, while the occlusal edge of the lingual surface is more or less straight. The central pit is shallow (because of the marked attrition) and it is slightly curved, the ends pointing towards parastyle and metastyle.

Roots. There are three roots, one lingual and two buccal, the one buccal being broken off at its base, while the other is partly broken. The roots are very short and tend to be triangular in shape.

Diagnosis. Its features and dimensions exclude it from the *Palaeotraginae*, such as *Giraffokeryx* and *Okapia*. The flat profile and slope of the lingual surface of the tooth are uncommon features among *G. camelopardalis* in which a rounded bell-shaped body is the typical shape, but they are observed in *G. gracilis* (Arambourg, 1947, pl. XXII, 1a). The only premolar known to represent *G. gracilis* is a P^4 which is smaller in its overall dimensions than that of *G. camelopardalis*.

Although 3345 falls within the range of *G. camelopardalis* both for A–P and transverse dimensions it tends to be at the lower end of the range. As it is not possible to compare 3345 directly with a *G. gracilis* specimen, it is tentatively assigned to *G. camelopardalis*. This view is strengthened by the fact that the Transverse/A–P index of 3345 is identical to the mean index (123) of P^2 in *G. camelopardalis*. Nevertheless it should be kept in mind that the non-metrical features of the Hopefield specimen are very suggestive of those of the *G. gracilis* premolar. This fact may be more significant than its metrical relationship to *G. camelopardalis* because of the extensive range of variation of the latter (table 7).

B. Sivatheriinae

(1) cranial fragments

4372 B (plate 42(*a*), (*b*))

Five fragments, found *in situ* associated with the horn-cores 4372, 4373 and 4373 A, were reconstructed to form the base of a skull in the region of the

foramen magnum. It contains portions of the two occipital condyles, most of the lower and most of the upper border of the foramen magnum and a portion of the occipital bone. On the inner aspect of the fragment, the bone structure consists of numerous large and small inter-connecting sinuses. The medial edges of the condyles project inwards slightly, decreasing the side-to-side breadth of the foramen magnum. The medial condylar surfaces are not complete, while the lateral articular portions are missing. The medial surfaces are slightly convex from side to side and fairly convex from front to back. There is a small groove on the postero-medial aspect of each condyle where it is continuous with the base of the skull. The striking features of the foramen magnum, viewed from the inferior aspect, are its large size and its almost circular appearance.

The postero-superior border of the foramen magnum forms a broad, flattened arc rather than the acute-angled arch of the modern giraffe. Although a portion of the bone is missing above this region, it is clear that the protuberant mass of solid bone where the two exoccipitals and the supraoccipital fuse in a triradiate fashion, which is present in the modern giraffe, is absent in the fossil specimen. In fact it appears that there is a thickened pillar of bone (the region of the exo-supraoccipital suture junction) leading up to the occipital crest. This feature is very similar to that observed in *Sivatherium giganteum* (see Falconer and Cautley, 1846–9, plate XCII, 1c), except that in the Hopefield specimen the postero-superior border of the foramen magnum appears broader than in *giganteum*. Furthermore, the postero-superior portion of the occipital condyle is angulated quite differently to the foramen magnum than in the modern giraffe in that the plane of this region of the condyle is parallel to the occipital surface, while in the modern giraffe it is almost at 90.° This may indicate that the skull was balanced on the vertebral column at an obtuse angle, rather than the right angle between the vertical axis of the upper cervical vertebrae and the plane of the base of the skull of the modern giraffe. Mechanically this would be in accordance with the short neck of the Sivatheriinae, which probably contained a group of powerful extensor muscles to assist in maintaining the balance of the large skull with its massive, heavy, curving horns.

Measurements	4372 B		*Sivatherium giganteum*[1]
	mm.	*inches*	*inches*
Minimum intercondylar breadth ..	56·0	2·2	2·6
Foramen magnum:			
Maximum A–P, internal	51	2·0	
Maximum A–P, external	58	2·3	2·3
Maximum breadth, external ..	58	2·3	
Maximum breadth, internal ..	61	2·4	

TABLE 37

[1] Falconer and Cautley, 1836.

4372 (plate 43)

This is a Sivatherine posterior horn-core (so-called 'antler') which was found to be fairly complete after reconstruction of the fragments. The base is

pear-shaped, narrow anteriorly, the posterior part being rather globular. The lower part of the horn-core, as high as the flange, is hollow, narrowing superiorly, and only at the lowest end (for *c.* 12 cm. from the broken edge) is sinus formation visible. The base is fragmented and incomplete, the anterior portion missing and the flange broken off at the anterior border. The body of the horn-core is fairly complete, but the tip is missing.

Just above the base the core turns outwards, and at the base of the second knob it begins to twist posteriorly and laterally, so that the outer surface tends to face anteriorly. The posterior border is rounded; the anterior border at, and above, the flange narrows (and it is more angular than at the base) while nearer the tip, above the second knob, the anterior border becomes rounder.

There are deep longitudinal grooves running up on the medial convex surface. There are three grooves very close together at the base of the flange apparently diverging up from a single point. At the upper end of the flange the posterior groove swings sharply towards the posterior border, while the anterior two slowly separate, and the posterior of these two swings more acutely backwards opposite the second knob. The anterior groove runs up parallel to the anterior border as far as the second knob where it crosses the medial surface posteriorly and upwards towards the tip. In addition, arising from the anterior part of the base, there are three other grooves which travel obliquely upwards (from a point behind that of the above-mentioned grooves) towards the posterior border opposite the middle of the flange, and there they tend to disappear towards the back.

Measurements (mm.):

Circumference at base	*c.* 400	
Circumference between flange and knob 2	*c.* 330	
Circumference 100 mm. above knob 2	*c.* 265	
Circumference at tip	—	
Total length along posterior border	*c.* 590	
	A–P	*Side-to-side*
Base	*c.* 117·0	*c.* 127
Between flange and knob 2	*c.* 130	82·0
Above knob 2 (100 mm.)	91·0	72·0
At tip	—	—

TABLE 38

4373 (plate 44)

A posterior horn-core, the partner of 4372. No additional features are observed on it as it has the same general appearance of 4372. But, viewed from the front, the anterior border has a distinct sinuous ('twisted') appearance (see also Old. 86 (BK II)). It is rather incomplete, especially on the anterior border and convex surface. Therefore, the measurements would all be approximate and as they would add nothing to what has been obtained from 4372, no measurements are given.

4373 A (plate 42(*c*), (*d*))

This is the posterior portion of an anterior horn-core found in association with 4372, 4373. One surface is markedly concave, leading from the base to an

irregular rounded knob (cf. C 431 from Orange Free State). No sinuses are visible at the base which is broken away. This is the first Sivatherine anterior horn-core to be described from Africa. Thus it becomes the paratype for *Sivatherium olduvaiense* (see 'Discussion', Section III).

Height of fragment ..	160 mm.
Tip of fragment ..	55 mm. (transverse) × 59 mm. (A–P).

4373 B

A number of small fragments found with 4373 which cannot be fitted into the reconstruction.

4372 a, b, c, etc.

Groups of fragments found in association with 4372. Some are tiny fragments of the horn-core, but there are also a few fragments of skull, too small for identification or description.

(2) TEETH

4025 (plates 45(*a*), (*f*), (*g*); 50(*a*))

This is an isolated tooth, a right P^3.

Buccal surface. There is a rounded cingulum. The posterior half of this surface is missing. The parastyle bulges markedly below the cingulum, while a deep cleft separates the parastyle from the paracone.

Lingual surface. The enamel is fairly rugose and there is a marked rounded cingulum.

Roots. There are three roots. The lingual root which represents the root of the protocone is massive and rounded, and it projects medially. The buccal roots are broken off, but the anterior appears larger than the posterior root.

General shape. The tooth is very large, the buccal surface being flattened, while the lingual surface is arc-shaped. The central pit tends to be U-shaped, its enamel surfaces being widely separated in the centre; the 'arms' of the U taper towards the anterior and posterior ends of the buccal surface. The enamel on the lingual aspect of the pit is evaginated into it posteriorly, and the dentine here contains a rounded cone of enamel (cf. Makapansgat, M 1114). The paracone is wide from side to side, and its dentine tapers both anteriorly and posteriorly.

4027 (plates 46(*a*); 47(*a*); 48(*a*)).

An incomplete isolated right upper molar, probably M^1, in rather advanced wear.

Buccal surface. Marked, rounded cingulum. The tooth is rather fragmented and the paracone is missing. The metacone is similar to that of M^2, 4023 (*vide infra*), and the mesostyle again is prominent.

Lingual surface. The rugosity is finer than in the other teeth. The cingulum is marked and rounded. There is a bulge below the cingulum which is more marked in the anterior than in the posterior pillar. In the posterior pillar, this bulge gives way to a sharp outward angulation of the lingual surface in the direction of the apex, similar to 4024 (*vide infra*). The two pillars meet on the lingual aspect, similarly to those of 4024, i.e. the folding of the two contiguous enamel sides of the pillars being in an anterior direction.

Occlusal surface. The dentine is hollowed out on the 4 cones, forming an arc in a side-to-side direction. The central pits tend to be U-shaped: as in many of the other upper molars, the enamel on the lingual side tends to be U-shaped, while on the buccal side it is V-shaped. The U-shaped side however is more worn than the V-shaped one.

The inner arms of the two pits are not continuous, although the enamel of the two arms are touching each other. As in M^2 (4023), the posterior part of the pit of the anterior pillar has an evagination directed buccally towards the mesostyle.

Roots. The lingual root is broad, thickened above each pillar and a vertical groove on the medial aspect demarcates the two parts. The posterior buccal root tends to be oval in shape and flattened from front to back in an antero-posterior direction. The anterior buccal root is missing.

4023 (plates 46(*b*); 47(*a*); 48(*a*))

An isolated left M^2, found in association with 4024, with which it establishes a contact. The tooth is in a rather advanced stage of wear.

Buccal surface. This is similar to 4024 (*vide infra*) but the mesostyle, which is here complete, is very marked and appears to be associated with the posterior rather than with the anterior pillar. In the central hollow of each pillar there is a slight ridge of enamel (the costa), stretching up from the cingulum towards the apex of the tooth. This is more marked on the anterior pillar. The parastyle is broken off.

Lingual surface. There is a marked cingulum below which there is a slight bulge in each pillar. The enamel is rugose. The enamel is raised in a marked ridge on the anterior aspect of the tooth (protostyle).

Occlusal surface. The anterior pillar is again larger than the posterior one, and both tend to be arc-shaped on the lingual aspect. The slope of the buccal and lingual aspects are similar to those of 4024 in that the lingual surface of the protocone has a more vertical slope than that of the hypocone, while this is reversed on the buccal surface where the metacone is more vertical than the paracone. The central pits are more V-shaped, although the apex of the V, which points lingually, is slightly flattened. The inner arms of the V of each pillar become continuous with each other in the region of the mesostyle. Just on the anterior side of this point the pit of the anterior pillar has a marked evagination, which almost reaches the enamel junction of the two pillars on the lingual aspect.

Roots. They present an identical appearance to those of M^3 (4024), but the tip of the lingual root tends to be angulated in a vertical direction, and the lingual root is shorter than the buccal ones. The posterior buccal root is larger than the anterior one; both are triangular in shape. The tips of the anterior and posterior buccal roots curve anteriorly and posteriorly respectively.

4024 (plates 46(*c*); 47(*c*); 48(*c*))

An isolated left M^3. It is fairly complete, rather cracked, with most of the buccal roots missing.

Buccal surface. The enamel is rather rugose and not as smooth as in the lower teeth. The cingulum is well marked and rounded but in the centre of each pillar the area just below the cingulum tends to be scooped out. The cingulum becomes continuous with parastyle, mesostyle and metastyle, forming costae, so that viewed occlusally, the surface has a hollowed-out effect between these three costae.

Lingual surface. The enamel is rather rugose. Below the rounded cingulum there is a slight bulge which is more emphasized on the posterior pillar. The enamel is thrown into horizontal ridges on the anterior and posterior surfaces about 5 mm. from the crown-root junction (forming the protostyle and hypostyle respectively). The lingual and buccal surfaces of the tooth tend to slope towards each other in the direction of the apex, as in 4023. On the posterior pillar, there is a marked depression between the hypocone and the metastyle, which tends to accentuate the metastyle. Similarly, there is a depression between paracone and parastyle. This 'pinched' effect emphasizing the metastyle and parastyle is found close to the crown-root junctions and is a common feature in Sivatherines (e.g. F 3655, C 426, MMK 3685). This effect may also be seen on the posterior side of the posterior buccal root (e.g. C 426, 4024). The junction between the anterior and posterior pillars is not marked, the enamel surface of each pillar being contiguous for about 6 mm. towards the centre of the tooth.

Occlusal surface. The shape of the lingual enamel edge of the two pillars is V-shaped, but the posterior is much narrower and smaller, the latter effect being produced by the more acute slope of its lingual surface towards the apex. The central pits are U-shaped, the central portion of the U being fairly wide, while the enamel sides of the 'arms' tend to come close together. The outer arms of each pit curve, one towards the parastyle and the other towards the metastyle, while the two inner arms are directed towards the mesostyle. The mesostyle is missing in part. The central portion of the U in the anterior pillar has a slight evagination posteriorly in a lingual direction. The image of this in the central pit of the posterior pillar is broken.

The tooth (as well as 4023) illustrates very well the typical occlusal wear. The enamel and the dentine are raised in a straight line from side to side in the centre of each pillar, while they are well worn along the anterior aspect

of the anterior pillar and the posterior aspect of the posterior pillar. Maximum wear has occurred along the contiguous surfaces of the two pillars.

Roots: The lingual roots of each pillar are fused by a plate, so that in effect one only finds one broad root on the lingual side, with the anterior pillar reflecting the largest bulge on the root. The two buccal roots are separated, but the posterior one is broken off near the base and the anterior root is broken at the crown-root junction. The lingual root is angulated in a medial direction. The buccal roots are arranged so that the posterior root points backwards, and the anterior one forwards and outwards.

4026 (plates 45(*b*), (*e*), (*i*); 50(*b*))

This is an incomplete isolated incisor. Assuming for the purpose of description that it is a right incisor, the anterior half of the crown is broken, mainly on the buccal aspect. The enamel is finely rugose. The enamel on the occlusal edge of the tooth on the buccal aspect is broader than it is at the crown-root junction. Looked at from the side, the 'apron' appearance of the enamel is again observed. On the posterior surface the enamel has a sharp ridge running up from the cingulum to the occlusal surface. The posterior surface on the lingual side of this ridge has no cingulum. Near the occlusal edge this ridge is worn, suggesting contact with a contiguous tooth. The lingual aspect of the tooth has no enamel, indicating that the tooth is in advanced wear, and the dentine is slightly raised at the crown-root junction.

On the buccal aspect, in the centre of the tooth, the enamel presents a groove which extends from the occlusal edge to the bulge above the cingulum.

Measurements of 4026 (*mm.*)

Total height	72+
Crown (buccal) height	34·7
Length (A–P)	*c.* 21
Maximum breadth at the crown-root junction	18·4

4374 (plates 46(*d*); 47(*d*); 48(*d*))

An isolated, very fragmented lower left molar, M_1 or M_2, found near 4029, 4029 A and B. It consists of the posterior root, part of the hypoconid and entoconid and a small piece of the protoconid. The tooth is very worn. The buccal enamel is rather rugose, the region of the cingulum is broken away and the lingual surface is also broken. In occlusal aspect, the central pit is visible, rather flattened in shape, with its anterior portion curving towards the metastylid.

Measurements of 4374 (*mm.*)

Buccal height	*c.* 17
Length of the hypoconid	*c.* 28

4028 (plates 46(*e*); 47(*e*); 48(*e*))

A fragment of left mandible, containing M_2 and M_3 (4028 A), in advanced wear.

M_3

Buccal aspect. The tooth is hypsodont and the enamel is fairly rugose. The cingulum is marked, more particularly on the posterior pillar and on the talonid; it is more rounded on the buccal than on the lingual side where it is only represented by a faint ridge. At the anterior part of the posterior pillar, the cingulum bulges in the region of the ectostylid.

Similarly on the talonid, at the anterior end of the cingulum, there is a nodular hypostylid. The protoconid tends to be angular on the buccal side, and even presents a slight vertical central ridge, which is not observed on the hypoconid.

Lingual surface. The rugosity is smoothed and even disappears opposite the centre of each pillar where there is a slight bulge (costa). At the base of the crown there is a bulge on each pillar, the posterior pillar having the larger bulge. The bulge on the posterior pillar, which is unusually prominent and extensive, tends to resolve itself in an upward direction in three ill-defined ridges: the posterior ridge travelling in the direction of the entostylid, the central ridge (costa) travelling towards the apex of the tooth, and the anterior ridge in the direction of the metastylid. The enamel of the crown of the anterior pillar and of the talonid is broken off.

About 30 mm. above the cingulum of the posterior pillar, on the lingual surface, the enamel forms a horizontal ridge which extends across the anterior pillar and towards the top of the talonid. There are also a few other irregularities of the enamel giving the appearance of ridges.

The buccal surface of each pillar looked at from the side is vertical, whereas the lingual surface is slightly angulated laterally towards the apex.

Occlusal surface. The protoconid and hypoconid form a triangle, but the apex on the buccal side is an obtuse angle of about 110°. The talonid is large; its occlusal view presents an oval surface, flattened from side to side, and its A–P axis is at an angle of 45° outwards to that of the other two pillars.

The central pit is irregular and flattened from side to side so that in the centre of each pillar the enamel of the two sides of the pits is almost touching. The pit is confined to two pillars and only extends very slightly on the occlusal surface into the talonid. The enamel on the buccal side is fairly regular and wavy, being indented at the junction between the two pillars, whereas the enamel at the lingual side gets broader and evaginates towards the parastylid and also towards the metastylid.

Roots. There are two roots: the anterior pillar having a single root which tends to bulge on both the buccal and lingual sides, these bulges being connected by a short flattened plate. The root tends to be vertical and it is separated by a triangular interval from the root of the posterior pillar.

In the region of the talonid the root is also thickened and continuous with the thickened portion of the posterior pillar by means of a hollowed-out plate, so that in effect one observes one massive root. The tips of the roots tend to curve buccally.

M_2

Buccal surface. There is a cingulum which is not as rounded as in M_3, but on the lingual surface it is slightly more exaggerated than in M_3. Also on the anterior surface of the anterior pillar, the cingulum is well marked. In the region of the ectostylid the cingulum tends to bulge somewhat.

Lingual surface. There is a slight bulge above the base of the posterior pillar, and the resolving upward ridges are similar to those in M_3, but less distinct. The bulge above the cingulum of the anterior pillar is less marked, and is really just a thickening of the cingulum; it appears to lead up to the broken parastylid. Towards the posterior part of the anterior pillar, another ridge (costa) stretches upwards from the cingulum towards the apex of the tooth, and between this ridge and the parastylid there is a slight depression. The enamel forms numerous horizontal ridges.

Occlusal surface. Each pillar has a separated central pit: the pits are only very slightly separated in the region of the metastylid; the posterior one tends to be the more irregular, because each end of its arc sweeps towards the metastylid and the entostylid respectively. The central pit of the anterior pillar broadens out anteriorly. The enamel surfaces of the two pillars sweep in towards each other at a sharper angle, so that they meet in a deep wedge between the two pillars. Once again the protoconid and hypoconid form angular apices on the buccal side; the apex of the posterior pillar being slightly more rounded.

On the occlusal surface of the posterior pillar, the dentine has a shallow pit on the hypoconid. This is probably a post-fossilization artifact.

Looking from the anterior aspect, the crown-root junction presents a horizontal line from the lingual surface towards the buccal, and just near the buccal surface the enamel projects down sharply like an apron. This is the best example of this 'apron' effect which is, in general, better displayed in the lower than in the upper teeth.

Roots. The posterior root is broad when viewed from the posterior aspect and towards the tip it curves posteriorly. The anterior root has a similar appearance, but the tip is shorter and less curved. On both roots, the buccal and lingual surfaces bulge more than the central portion of the root. At the crown-root junction, between the two pillars, an accessory rootlet projects down from the anterior pillar for a short distance. The tip is broken.

4029 (plate 49)

Part of the horizontal ramus of a left mandible with M_3, M_2 (4029 B) and part of the root of M_1. The teeth are in advanced wear.

M_3

Almost complete, deeply stained by ferricrete (see Introduction to Chapter 4).

Buccal surface. It is fairly rugose with a markedly rounded cingulum. The ectoconid is marked and pillariform although broken off just below the occlusal level. Just above the cingulum each pillar is rather rounded. Because of the bulge, that part of the buccal surface above it tends to slope lingually, whereas the lingual surface appears to be at about the same angle as in 4028.

The talonid appears to be angulated to the A–P plane of the pillars, but less than in 4028. It has a rounded appearance because of a large bulge of the crown above the cingulum.

Lingual surface. Rather broken. The cingulum is not rounded and not as pronounced as on the buccal side. The surface presents similar features to 4028.

Occlusal surface. The central pit is very similar to 4028. Despite a greater degree of wear, the central pits of the anterior and posterior pillars are not confluent. The ridges of enamel of each pit lie in contiguity. The buccal enamel of the pillars is arc-shaped rather than triangular.

Roots. Appear to be the same as in 4028.

M_2

Incomplete and rather cracked, but most of the features can be recognized. The general appearance is similar to M_2 of 4028.

Buccal surface. Marked, rounded cingulum with a bulge above it on each pillar. There is an obvious ectostylid.

Lingual surface. The crown-root junction between the pillars appears to be more angulated upwards than in 4028.

Occlusal surface. The central pit of the anterior pillar is small and asymmetrically placed towards the anterior end of the tooth; the central pit of the posterior pillar is very compressed in its anterior half; the posterior half presents a small triangular pit, and is very similar to the same region in M_2 of 4028. Anteriorly the pit does not extend beyond the junction of the anterior and posterior pillars, as it does in 4028. These differences however are probably due to wear. The general shape in occlusal view is the same as in 4028.

Roots. Viewed from the front, the apron effect of the crown-root junction is not as marked as in 4028.

M_1

The posterior root is present. It is broad from side to side, and flattened antero-posteriorly.

Measurements of mandible (mm.)

Breadth opposite posterior pillar of M_3 ..	c. 37
Breadth opposite posterior pillar of M_2 ..	c. 47

4030

This is a fragment of a right M_2, the roots of which are completely absent. Most of the posterior pillar has been reconstructed, while only a small piece

of the buccal surface of the anterior pillar remains. Although the tooth was found in a number of fragments, these have been rejoined at only the obvious contact surfaces. Because of the angulation of the fragment, the central pit could be wider which would give the tooth an increased breadth, but it was decided to replace the fragments at their minimum breadth.

Although the tooth is in fairly advanced wear, it is hypsodont. From a rounded cingulum the buccal surface slopes medially at a fairly acute angle, and just near the occlusal edge the surface tends to be more vertical. The lingual surface slopes upwards and laterally from the base, so that the width of the tooth at the crown-root junction is far greater than at the occlusal edge.

Buccal surface. The enamel is rather rugose and the buccal surface is irregular. The posterior surface shows a marked indentation at the crown-root junction. There is a small ectostylid present leading from the rather rounded cingulum of the anterior pillar. There is a small bulge above the cingulum of the anterior pillar.

Lingual surface. Only a small fragment of the entoconid remains, but it can be seen from this that the central costa is flattened; there is a slight groove separating the upper portion of the costa from the fragmented remains of the entostylid.

Occlusal surface. A small portion of the central pit remains. It can be ascertained that the occlusal edge of the buccal surface has a broad U-shape.

4031

This is a fragmented portion of an isolated right M_3 in which the talonid is fairly complete, but only a portion of the posterior pillar remains. Most of the posterior root is present. It is most probable that this tooth and 4030, found near it, belong to the same jaw. The tooth appears to have been in fairly advanced wear. It is markedly hypsodont.

Buccal surface. The talonid is very large, presenting a marked cingulum above which the crown surface is not regular. There is a broad flattened bulge above the cingulum and an indentation (convexity towards the lingual surface) just above this at about two-thirds of the distance up from the crown-root junction. The enamel is rather rugose. The posterior half of the buccal surface of the hypoconid is present and has a round cingulum; the surface of the pillar has two indentations, one just above the cingulum and one at about two-thirds of the height from the cingulum. These abnormalities of the surface of the tooth appear to be a purely local phenomenon (? ecological or dietary variation), because anomalies of the enamel are also observed on Hopefield 4028 and 4029.

Lingual surface. The cingulum is represented only by a thin ridge above which there is a bulge on the talonid, and although most of the lingual surface of the entoconid is missing, sufficient remains to indicate that there is a rounded bulge above the cingulum similar to that in 4028 A.

Specimen	Length					Breadth						Height					
	Tooth		Anterior Pillar	Posterior Pillar	Talonid	Tooth		Anterior Pillar		Posterior Pillar		Anterior Pillar		Posterior Pillar		Tooth Height	
	Max.	*Occl.*	*Occlusal*	*Occlusal*	*Occlusal*	*Max.*	*Occl.*	*Max.*	*Occl.*	*Max.*	*Occl.*	*Lingual*	*Buccal*	*Lingual*	*Buccal*	*Lingual*	*Buccal*
A Milk																	
*DM*²																	
M 646 ..	21·8	.	.	.	.	15·5	.	.	.	.	.	.	.	.	.	10·0	12·8
M 944 ..	21·7	.	.	.	.	15·9	.	.	.	.	.	.	.	.	.	16·0	13·4
*DM*³																	
M 263 ..	22·0	22·0	.	.	.	20·7	.	.	.	.	.	10·8	11·0	.	.	.	.
M 536 ..	26·0	26·0	.	.	.	22·2	.	.	.	.	.	14·4	14·3	.	.	.	.
*DM*⁴																	
M 263 ..	24·5	24·4	12·2	11·6	.	24·0	.	23·1	15·3	23·0	13·4	13·0	12·5	10·3	15·0	.	.
M 1115 ..	26·1	26·0	10·8	12·5	.	24·7	.	24·7	15·4	24·0	12·9	14·3	15·2	15·4	16·5	.	.
M 535 ..	*c.* 24	*c.* 24	12·5	12·3	.	25·2	.	24·9	14·0	22·9	11·0	16·1	16·4	16·0	16·7	.	.
M 533 ..	27·4	27·4	10·0	13·2	.	26·5	.	24·7	13·6	24·6	9·7	15·4	18·3	15·2	17·5	.	.
DM_2																	
M 540 ..	14·5	.	.	.	.	8·6	.	.	.	.	.	.	.	.	.	9·3	9·1
M 939 ..	15·7	15·2	.	.	.	8·4	.	.	.	.	.	.	.	.	.	9·4	8·3
DM_3																	
M 540 ..	21·1	.	.	.	.	12·4	.	.	.	.	.	.	.	.	.	9·0	8·6
M 939 ..	22·3	.	.	.	.	13·7	.	.	.	.	.	.	.	.	.	9·6	10·2
DM_4																	
M 540 ..	34·0	.	9·5	10·1	13·1	17·8	.	.	.	.	.	15·0	14·0	.	.	.	.
B. Adult																	
*P*²																	
3345 ..	18·9	18·9	.	.	.	23·3	17·9	.	.	.	.	.	.	.	.	8·2	13·5
M 532 ..	21·6	.	.	.	.	28·1	15·7	.	.	.	.	.	.	.	.	17·6	19·3
*P*³																	
M 1114 ..	*c.* 29	.	.	.	.	29·0	.	.	.	.	.	.	.	.	.	17·3	*c.* 19
M 531 ..	26·0	26·0	.	.	.	30·5	.	.	.	.	.	.	.	.	.	9·8	11·0
M 264 ..	25·8	25·8	.	.	.	29·7	28·8	.	.	.	.	.	.	.	.	10·7	12·5
*M*¹																	
M 552 ..	28·8	28·3	*c.* 16	*c.* 14	.	*c.* 29	.	.	.	*c.* 26	15·0	.	29·5	14·2	18·4	.	.
M 551 ..	28·8	28·8	12·8	14·1	.	28·7	.	28·7	14·9	27·2	11·0	22·7	22·1	21·4	22·4	.	.
M 263 ..	29·5	29·4	11·0	15·4	.	32·6	.	32·4	16·1	31·4	12·0	20·7	23·2	20·8	22·1	.	.

M^2																	
M 528 . .	c. 30	c. 30	12·0	15·0	.	c. 33	.	.	.	29·6	23·3	7·6	.	8·8	10·8	.	.
M 550 . .	c. 34	c. 34	16·3	c. 17	.	37·2	.	36·7	30·3	33·8	27·0	11·1	11·0	9·2	9·3	.	.
M^3																	
M 528 . .	c. 26	c. 25	12·1	c. 13	.	c. 26	.	c. 26	.	.	.	8·6	.	6·2	.	.	.
M_2																	
M 1113–942	36·7	35·8	17·2	17·2	.	26·5	.	26·4	18·4	25·3	12·0	27·1	c. 24	28·4	24·8	.	.
M 936 . .	32·8	32·3	14·7	17·0	.	23·1	.	.	.	22·7	23·5	14·3	.	15·9	8·4	.	.
M_3																	
M 938 . .	49·5	38·2	16·6	13·8	7·2	c. 24	.	c. 24	10·0	.	8·9	27·0	.	.	.	.	.

TABLE 39. Measurements of teeth of African fossil *Giraffa* (mm.).
All the specimens are from Makapansgat except 3345 which is from Hopefield.

Specimen	Length: Tooth Max.	Length: Tooth Occl.	Length: Anterior Pillar Occlusal	Length: Posterior Pillar Occlusal	Length: Talonid Occlusal	Breadth: Tooth Max.	Breadth: Tooth Occl.	Breadth: Anterior Pillar Max.	Breadth: Anterior Pillar Occl.	Breadth: Posterior Pillar Max.	Breadth: Posterior Pillar Occl.	Height: Anterior Pillar Lingual	Height: Anterior Pillar Buccal	Height: Posterior Pillar Lingual	Height: Posterior Pillar Buccal	Height: Tooth Height Lingual	Height: Tooth Height Buccal
A. Milk																	
DM^3																	
B^1	41·0	40·8	22·8	18·1	.	32·9	.	31·5	20·0	32·5	18·3	24·2	26·7	21·9	30·2	.	.
M 524 ..	42·7	42·4	18·6	20·3	.	32·7	.	28·8	15·2	32·4	15·6	21·3	24·9	21·8	29·0	.	.
DM^4																	
B^2	46·7	46·7	19·4	23·8	.	39·7	.	36·7	18·2	39·0	16·5	29·6	35·2	27·9	40·6	.	.
M 937 ..	*c.* 43	*c.* 43	18·6	22·3	.	40·0	.	*c.* 39	18·0	36·0	15·7	*c.* 31	*c.* 30	*c.* 30	33·0	.	.
M 941 ..	*c.* 44	.	*c.* 19	*c.* 22·5	.	*c.* 38	.	.	.	.	.	.	.	.	.	.	.
DM_3																	
M 525 ..	33·1	33·0	.	.	.	17·9	.	.	.	.	.	.	18·4	.	18·1	.	.
DM_4																	
M 539 B ..	*c.* 55	*c.* 53	17·7	14·8	*c.* 20	24·0	.	20·6	10·9	24·0	13·0	26·2	.	27·0	*c.* 26	.	.
B. Adult																	
P^3																	
4025 ..	.	*c.* 39	.	.	.	*c.* 44	36·6	.	.	.	.	.	.	.	.	25·5	33·3
F 2989 ..	*c.* 34	*c.* 34	.	.	.	*c.* 43	.	.	.	.	.	.	.	.	.	0	13·0
F 39 (?) ..	.	.	32·5	.	.	.	.	*c.* 40	25·3	.	.	.	*c.* 67	.	.	.	.
M^1																	
F 3655 ..	*c.* 38	.	.	.	.	*c.* 47	.	.	.	*c.* 47	*c.* 41	.	.	7·7	8·4	.	.
4027 ..	*c.* 45	.	*c.* 21	*c.* 23	.	54·8	.	.	.	50·6	37·5	22·5	.	20·0	32·9	.	.
C 426D ..	.	.	*c.* 20	.	.	.	.	.	.	.	.	11·0	.	.	.	.	.
M^2																	
F 3655 ..	46·3	46·3	21·3	19·5	.	48·1	.	47·7	41·8	47·8	37·2	11·5	16·3	9·5	16·2	.	.
F 2993 ..	*c.* 48	.	*c.* 20	*c.* 25	.	*c.* 54	.	.	.	47·2	*c.* 25	29·0	.	*c.* 30	*c.* 43	.	.
4023 ..	*c.* 49	*c.* 49	23·2	21·0	.	47·0	.	*c.* 44	36·2	43·2	31·0	23·1	32·3	20·0	37·4	.	.
C 426B ..	.	.	25·0	*c.* 26	.	.	.	.	.	.	.	.	.	8·6	.	.	.
C 426C ..	.	.	24·8	22·4	.	.	.	.	.	.	.	.	.	11·2	.	.	.
M^3																	
F 3655 ..	49·5	49·3	20·8	19·7	.	46·0	.	46·0	37·2	40·1	*c.* 32	8·8	18·7	11·0	*c.* 19	.	.
4 BK II ..	44·0	*c.* 44	21·4	18·8	.	*c.* 49	.	*c.* 49	39·7	.	.	13·6	22·1	11·6	.	.	.
109 BK II	51·0	49·1	27·5	22·7	.	50·5	.	50·5	26·3	46·0	*c.* 11	40·6	47·0	*c.* 43	50·0	.	.
4024 ..	53·0	53·0	30·0	20·8	.	46·0	.	42·0	*c.* 34	39·6	28·0	23·5	.	*c.* 23	35·2	.	.
C 426A ..	*c.* 60	*c.* 60	27·5	23·5	.	51·9	.	51·9	*c.* 46	47·7	40·7	9·8	.	7·6	21·6	.	.

MMK3685	53·8	53·6	21·0	24·0	.	54·6	.	54·6	32·9	c. 50	26·3	25·8	c. 34	c. 27	c. 32	.	.
P_2																	
6	26·0	22·8	.	.	.	19·8	17·8	.	.	.	.	.	.	.	.	22·3	21·0
M 553A ..	c. 26	.	.	.	.	c. 18	.	.	.	.	.	.	.	.	.	c. 21	c. 24
M 553B ..	c. 26	.	.	.	.	c. 17	.	.	.	.	.	.	.	.	.	c. 22	c. 22
P_3																	
365 ..	34·0	33·5	.	.	.	25·2	23·4	.	.	.	.	.	.	.	.	17·1	17·9
6	36·3	35·8	.	.	.	29·5	27·2	.	.	.	.	.	.	.	.	18·6	19·0
M 553B ..	c. 36	c. 33	.	.	.	c. 23	.	.	.	.	.	.	.	.	.	c. 35	.
P_4																	
365 ..	37·0	37·0	25·1	10·5	.	28·3	.	28·3	26·2	28·0	25·8	17·1	c. 18	15·7	13·3	.	.
1	41·4	40·6	27·5	11·7	.	28·3	.	27·6	27·6	28·3	26·6	26·3	18·7	20·8	16·4	.	.
6	42·4	42·4	26·0	12·3	.	32·4	.	29·4	29·4	32·4	30·0	28·2	20·8	23·9	16·7	.	.
5	46·0	45·9	31·4	10·2	.	32·0	.	30·8	14·0	32·0	20·5	51·7	50·4	42·3	38·2	.	.
7	47·4	47·4	32·0	.	.	c. 31	.	c. 31	9·8	28·5	15·0	.	.	.	c. 37	.	.
F 2991 ..	40·6	40·6	27·3	10·3	.	31·4	.	28·5	28·5	31·4	31·4	36·3	26·6	30·0	16·0	.	.
2	39·6	38·8	29·0	8·9	.	29·9	.	29·9	c. 27	28·4	29·9	35·0	c. 33	36·0	c. 21	.	.
M_1																	
F 3656 ..	.	.	.	19·0	.	33·2	.	.	.	33·2	30·4	.	.	16·1	15·6	.	.
91	.	.	.	c. 22	.	38·8	.	.	.	38·8	34·6	.	.	.	.	.	.
Nguntiri ..	c. 47	c. 46	c. 22	22·5	.	32·9	.	32·0	c. 27	32·9	29·7	c. 20	20·1	c. 18	18·3	.	.
365 ..	c. 46	c. 46	21·8	c. 24	.	33·3	.	33·3	32·8	32·7	31·3	9·2	10·2	11·5	15·5	.	.
1	c. 44	c. 44	c. 23	21·6	.	33·2	.	32·6	30·7	33·2	30·2	27·0	24·4	23·7	22·6	.	.
6	44·0	44·0	20·4	21·0	.	39·5	.	33·2	30·8	39·5	36·7	18·8	16·7	18·0	11·4	.	.
M 553B^{1} ..	c. 49	c. 47	c. 22	22·9	.	34·7	.	31·2	c. 22	34·7	c. 21	36+	31·7+	39+	36·6+	.	.
105 ..	47·8	44·8	22·2	22·1	.	27·9	.	27·9	25·0	26·0	23·0	c. 29	23·4	c. 27	.	.	.
132 ..	c. 43	c. 43	c. 22	19·8	.	29·0	27·3	27·3	24·7	29·0	27·0	c. 16	19·2	0	16·0	.	.
8	.	.	23·5	.	.	.	.	32·7	26·6	.	.	35·0	32·0	.	.	.	.
116 ..	c. 47	.	c. 25	c. 23	.	.	.	c. 28	13·0	.	.	c. 54	c. 46	.	.	.	.
M_2																	
F 3656 ..	50·6	50·6	25·5	22·6	.	36·5	.	34·1	29·7	36·5	33·5	26·1	22·7	21·8	16·6	.	.
92	50·2	50·2	26·4	24·1	.	33·7	.	33·7	21·4	33·2	20·6	42·7	c. 35	c. 41	c. 32	.	.
392 ..	52·4	52·4	26·0	25·7	.	35·0	.	33·2	29·6	34·6	31·0	19·4	17·3	22·5	15·0	.	.
91	53·8	53·4	27·4	25·5	.	38·0	.	36·6	.	38·0	30·1	.	26·9	37·7	27·2	.	.
321 ..	c. 51	c. 51	c. 25	23·5	.	36·8	.	c. 36	c. 30	36·8	33·1	28·0	23·2	24·0	17·3	.	.
Nguntiri ..	48·5	48·0	24·4	23·3	.	33·8	.	33·8	28·4	33·6	27·5	25·1	22·8	c. 27	26·5	.	.
1	48·6	48·6	c. 25	23·9	.	33·6	.	33·6	28·7	c. 34	.	c. 25	26·6	.	27·6	.	.
6	52·8	52·8	27·3	24·8	.	40·2	.	39·8	32·0	40·2	35·0	27·6	20·9	c. 25	20·1	.	.
4028 ..	c. 55	c. 55	c. 28	c. 28	.	.	.	.	.	38·2	31·8	.	.	30·0	31·5	.	.
4029 B ..	c. 49	c. 49	c. 24	c. 23	.	.	.	.	.	32·3	32·3	.	.	26·1	c. 24	.	.
M 553B^{1} ..	c. 53	c. 52	28·0	22·8	.	33·2	.	33·2	19·1	33·0	18·8	39+	36·2+	41+	33·3+	.	.

Specimen	Length					Breadth						Height					
	Tooth		Anterior Pillar	Posterior Pillar	Talonid	Tooth		Anterior Pillar		Posterior Pillar		Anterior Pillar		Posterior Pillar		Tooth Height	
	Max.	*Occl.*	*Occlusal*	*Occlusal*	*Occlusal*	*Max.*	*Occl.*	*Max.*	*Occl.*	*Max.*	*Occl.*	*Lingual*	*Buccal*	*Lingual*	*Buccal*	*Lingual*	*Buccal*
M 943 ..	.	.	.	24·5	.	.	.	.	.	.	c. 19	.	.	.	49+	.	.
C 1492* ..	.	60·8	.	.	.	.	.	.	19·4	.	24·2	.	.	.	.	.	.
4030 ..	.	.	.	c. 29	.	.	.	.	.	c. 40	c. 26	.	.	.	43·0	.	.
100 ..	.	.	.	.	.	.	.	.	.	.	.	.	.	c. 50	.	.	.
95	c. 50	c. 50	25·5	23·6	.	36·9	.	35·0	25·4	36·9	c. 30	38·0	32·0	c. 29	31·0	.	.
166 ..	50·5	50·5	27·7	22·1	.	33·5	.	30·8	23·9	33·5	c. 26	39·3	39·0	.	c. 35	.	.
M_3																Ratio: *Occl. L. Tal./Occl. L. Tooth*	
F 3656 ..	68·2	68·0	25·4	21·4	20·0	34·8	.	34·8	28·7	34·0	29·4	28·7	24·3	28·0	24·6	29·4	
92	59·0	58·6	25·0	21·5	12·3	31·7	.	31·7	19·0	30·7	18·5	c. 46	c. 34	49·8	c. 32	21·0	
3	c. 74	c. 69	c. 26	24·5	21·7	c. 31	.	c. 31	c. 27	c. 28	c. 28	.	25·0	.	25·7	31·4	
Nguntiri ..	.	.	22·5	.	.	.	.	c. 31	25·0	.	.	c. 27	24·0	.	.	.	
93	68·7	65·6	23·0	21·4	20·1	32·1	.	32·1	.	30·8	.	0	12·5	0	12·5	30·6	
1	68·2	c. 65	25·0	22·3	17·1	32·1	.	32·1	26·2	30·3	27·6	.	32·7	38·2	29·3	26·2	
4028A ..	c. 77	c. 72	29·0	24·1	c. 18	c. 34	.	c. 34	26·9	32·9	27·2	.	37·8	c. 39	37·3	25·0	
4029 ..	c. 73	c. 71	c. 26	25·5	c. 18	33·8	.	33·8	31·9	31·4	28·4	30·8	26·7	c. 28	28·0	25·4	
6	66·0	66·0	26·2	22·0	17·4	39·7	.	39·7	29·8	36·4	28·4	c. 34	c. 28	38·4	31·3	26·4	
120 ..	63·6	62·1	23·3	19·7	19·1	35·5	.	35·5	31·0	33·3	c. 32·4	26·7	18·6	29·8	18·2	30·7	
4031 ..	.	.	.	.	c. 21	.	.	.	.	c. 33	.	.	.	.	c. 46	27·3	
Marsabit..	.	.	c. 24	22·4	.	31·5	.	31·5	30·1	29·0	29·0	c. 23	18·5	c. 23	20·6	.	

Table 40. Measurements of teeth of Africa Sivatheriinae.

Makapansgat : M 524; M 937; M 941; M 525; M 539B; M 553A; M 553B; M 553B¹; M 943.
O.F.S. : B¹; B²; F 39; C 426A; C 426B; C 426C; C 426D; MMK 3685; C 1492.
Olduvai : F 2989; F 3655; F BK II; F 2993; 109 BK II; 6; 365; 1; 5; 7; F 2991; 2; F 3656; 91; Nguntiri; 105; 132; 8; 116; 92; 392; 321; 100; 95; 166; 3; 93; 120; Marsabit Road.
Hopefield : 4025; 4027; 4023; 4024; 4028; 4028A; 4029; 4029B; 4030; 4031.

Occlusal surface. The occlusal surface is extremely broken but it can be seen that the talonid is angulated slightly to the longitudinal axis of the tooth in a lateral direction. The talonid is large and oval.

4030 A

These are a number of small fragments found in the vicinity of 4030 and 4031, which cannot be included in their structure. They consist of the tips of two lower molar roots and many small fragments of cones.

SECTION III

GENERAL DISCUSSION AND CONCLUSIONS

SUB-ORDER Ruminantia

FAMILY Giraffidae

SUBFAMILY Sivatheriinae

Genus SIVATHERIUM Falconer & Cautley 1835–6

(Syn. INDRATHERIUM Pilgrim, G. E., 1910. *Rec. Geol. Surv. India*, **40**, pt. 1, 63)

Sivatherium olduvaiense Hopwood 1934*

* Hopwood's specific name is retained, but the masculine form *olduvaiensis* is here corrected to the neuter *olduvaiense*, a form which Hopwood used in 1936 but dropped in 1937.

1934 *Helladotherium olduvaiensis* Hopwood, *Ann. & Mag. Nat. Hist.* (10) *17*, 546.

1936 *Sivatherium olduvaiense* Hopwood, *Ann. & Mag. Nat. Hist.* (10) *17*, 636.

1937 *Sivatherium olduvaiensis* Hopwood. Dietrich, W. O., *Wissensch. Ergebnisse der Oldoway Exped.* 1913. Dr. H. Reck, edit., p. 106.

1942 *Sivatherium olduvaiense* Hopwood. Dietrich, W. O., *Palaeontographica*, *94*, A: 43.

1947 *Griquatherium cingulatum* Haughton. Cooke, H. B. S., & Wells, L. H., *S. Afr. J. Sci.*, *43*, 232.

1948 *Sivatherium olduvaiense* Hopwood. Arambourg, C., *Mission Scientifique de l'Omo* (1932–3). T. *1*, Fasc 3, Paléontologie, Paris, Mus. d'Hist. Nat., p. 376.

1948 *Libytherium maurusium* Pomel. Arambourg, C., *C.R.S. Soc. Géol. France*, Paris, p. 178.

1953 *Sivatherium* sp. Dreyer, T. F., *Res. Nas. Mus.*, Bloemfontein, *1*, pt. 3, p. 74.

Sivatherium olduvaiense vanhoepeni subsp. nov.

1932 *Orangiatherium vanrhyni* van Hoepen, *Pal. Nav. Nas. Mus.*, *2*, pt. 5, 63.

Sivatherium olduvaiense haughtoni subsp. nov.

1949 *Griquatherium haughtoni* Cooke, *Geol. Surv. Mem.* No. 35, pt. 3, 58.

Sivatherium olduvaiense subsp. indet.

Two milk molars from ? Cornelia ? Florisbad. See this paper, p. 526.

Sivatherium cingulatum (Haughton)

1922 *Griquatherium cingulatum* Haughton, *Trans. Geol. Soc. S. Afr.*, *24*, 11.

Genus LIBYTHERIUM Pomel 1892

1892 *Libytherium maurusium* Pomel, *C.R. Acad. Sci.* (Paris), *115*, 100.

CHAPTER I

SUMMARY OF OBSERVATIONS ON AND VARIATIONS IN SIVATHERINES

A. Cranial Fragments

(1) skull

The only fragment of a skull known from Africa is specimen 4372 B from Hopefield. The predominant features are the great circular size of the foramen magnum, the absence of the supraoccipital bulge and the orientation of the occipital condyles (see page 475).

(2) horn-cores

There are two pairs of horns, the major features of which are:

(*a*) *Anterior horn-cores.* There are two African specimens from which conclusions may be drawn, namely, at Hopefield and at Tierfontein (O.F.S.). The Hopefield specimen is incomplete, but the available fragment corresponds closely to the corresponding region of the Tierfontein specimen. The conclusions are based on the pooling of observations on both specimens. The horn is short, with cranial sinuses projecting slightly into the base. The horn is flattened from side to side, presenting two surfaces and two borders. The anterior border is rounded and has a peculiar cauliflower-like prominence superiorly. The posterior border is also rounded medio-laterally, but from above downwards it presents a concavity facing posteriorly. The one surface is particularly marked by deep grooves, especially near the front. As will be demonstrated in the discussion below, the Hopefield and Tierfontein material are to be referred to *S. olduvaiense*. The Hopefield specimen 4373 A becomes the paratype, because the authors identified it as an anterior horn-core before studying the Tierfontein specimens. Van Hoepen (1932) mentioned only the posterior horn-core definitively, but did not recognize the other specimen (van Hoepen's 'terminal fragment') as an *anterior* horn-core. He also did not indicate that either specimen belonged to the giraffids.

(*b*) *Posterior horn-cores.* Posterior horn-cores have been recovered from North Africa—St. Arnaud (Arambourg, 1948), Aïn Hanech (near St. Arnaud) and Garet Ichkeul (Tunisia) (Arambourg, 1949)—East Africa (Olduvai Gorge), and South Africa (Tierfontein and Hopefield). The features common to all of these are:

(i) Posterior horn-cores are of great length, averaging 640 mm. along the posterior border (range 560–840), and of great size, averaging 390 mm. circumference at the base (range 330–410 mm.) (table 41).

(ii) The base is rounded or pear-shaped and is hollowed out by the cranial sinuses.

	Hopefield 4372	Tierfontein 431	St. Arnaud 1948–1–1	St. Arnaud 1948–1–2	Olduvai M 14955	A.M.N.H. 19774	86 Old. Bk II 1952	1.53 Old.	2.53 Old.	3.53 Old.	SHK II Bk II (Base) S. Old. 1952 *plus* M 14954*b* Old. Bk II S
Total length of fragment											
Outer curve				900			810	950	1010	700	840
Posterior border	590	570	780	660	560		710	840	690	430	580
Circumference											
Base	400	360	390	430			415	400	390	360	330
Between flange and knob 2	330	345	290	300		280	350	410	420	360	350
100 mm. above knob 2 ..	265	258	275	250			330	300	290	310	
At knob 3		255						330	290	360	360
Between knobs 3 and 4 ..							300	280	250	250	270
At tip			137	160				170	170	150	150
A–P diameter											
Base	117	135	110	140			150	159	145	138	117
At base of flange					190		128	154	172	146	
At highest part of flange ..					165						
Between flange and knob 2	130	137	110	115		106	145				
100 mm. above knob 2 ..	91	93	98	92	117		119	105	101	122	
At knob 3		97			88		130	129	104	141	141
At tip			42	55	46		75	52	59	52	49
Side to side											
Base	127	87	98	110			114	127	90		100
At highest part of flange ..					58						
Between flange and knob 2	82	79	70	75		94	89	79	81	77	
100 mm. above knob 2 ..	72	71	65	65	54					70	
At knob 3					53		83	76	75	68	66
At tip			42	45	40		63	52	47	43	46
Flange length				145				267	155		
Internal height of base .. .. (Hollowed by sinuses)			150	150			170		300	130	80
Knob 2, length				90							
Knob 2, base A–P				650							

TABLE 41. Dimensions of posterior horn-cores (mm.) of *Sivatherium olduvaiense*.

(iii) The body of the horn-core is hollow for a varying extent.

(iv) Quite distinct from Cautley's specimen of the 'palmated antler' of *S. giganteum* (Falconer, 1868, I, pl. 21, fig. 3),* the African specimens generally are rounded or oval-shaped. The African specimens present a narrow convex anterior border and a rounded concave posterior border which also has a spiral twist, so that the anterior border becomes superior near the tip and the posterior becomes inferior, i.e. anti-clockwise (right horn) or heteronym (following the terminology of Lydekker, 1913). The horns are characterized by a flange-like projection (which varies in extent) of the anterior border just above the base, and knob-like projections (usually at least three) of varying size along the anterior border above the flange.

It has been clearly demonstrated in Section 1, chapter 7, that in the modern *Giraffa camelopardalis* there are tremendous sex and individual variations within the species. It has been indicated that the previous sub-specific ecological criteria and horn variations are not valid.

There can be no doubt that the dentitions of the *Sivatherium* specimens presently found at Olduvai belong to a single species, *olduvaiense*, in common with those from Hopefield, Port Allan (Tierfontein), Makapansgat, Omo, and Garet Ichkeul. The horn-cores assigned to this species from these sites show a range of variation as wide as that in the modern giraffe. There are degrees of curvature in an antero-posterior direction and also of twisting or torsion. The torsion varies from nothing to almost 90°. This enormous range is found at Olduvai where most of the specimens are curved in an A–P direction with only a slight or medium degree of lateral twist, while a few are twisted markedly so that the planes of the surfaces alter and the horn develops an 'antler' effect. The twist usually occurs just at or above the flange. Unfortunately there are no associations with these horns to indicate the sex of the animals; possibly the males, as in the modern giraffe, show the most marked variations. The few *Sivatherium giganteum* horn fragments found may well be at this extreme range of (? male) variation of torsion, giving a fairly constant 'antler-like' appearance, as described previously.

There are also variations in the number, position and size of the knobs. In some specimens they are evenly distributed along the anterior border. In the horns with marked torsion one or more of the lower knobs get shifted towards the back. The posterior 'branch' or knob on *Sivatherium giganteum* may well again be an extreme example of this. In other specimens the knobs are unevenly distributed, and in a few they tend to be clustered close together near the base of the horn, thus leaving a long smooth anterior border leading up to the tip.

* However, fragment AMNH 19774 (from the Siwaliks), referred by Colbert (1935) to ? *Sivatherium*, is distinctly rounded and is characterized by features observed in the African specimens.

There is no sex dimorphism in the dentition of the modern *Giraffa camelopardalis*. The teeth of *Sivatherium olduvaiense* from each site tend to fall within a single wide range of variation. Based upon the above discussion, it is unreasonable to separate the horn-cores at Olduvai into two species merely because of the fact that some are more markedly twisted than others. The small differences between individuals produce a gradation where the specimens at each end of the range appear to differ fairly widely from each other. But the same, but not correlated, difference can be obtained for the size and the shape of knobs and the A–P curve.

Arambourg (1948) states that *Libytherium* horn-cores differ from other Sivatheriinae, and in particular from the genus *Sivatherium*, because they are not so branched. He refers to the number and size of the knobs, and the torsion of the horns. However, the question of the 'branching' has been discussed above and it, as observed in the African specimens, does not provide a generic or specific criterion of distinction. Furthermore, the North African (St. Arnaud) horn-cores* do not differ essentially from those of the other African Sivatheriinae. In actual fact, it will be demonstrated later in the discussion that for many reasons (one feature being the horn-cores), part of the *Libytherium maurusium* material must be referred to *Sivatherium*.

(v) On the antero-medial convex surface† characteristic and more or less parallel grooves of varying length and depth sweep upwards from the anterior part of the base. The significance of the grooves is not clear. Because of the fact that they appear to radiate from a single point of origin at the base, one gains the impression that they may be of vascular origin (one could compare these with the appearance of the middle meningeal vessels on the interior of a skull). This view had previously been accepted (Abel, 1904; Colbert, 1935; Arambourg, 1948).

However, first, most of the grooves do not decrease in size proportionately to their distance from the origin, which one would expect if they were vessels.

Secondly, one could surmise that a massive horn-core would require a large blood supply, but this argument falls away when one considers that the small anterior horn-cores (about one-quarter of the length and

* These have been studied at the Muséum National d'Histoire Naturelle, Paris, by kind permission of Professors Arambourg and Lehman. The descriptions are not included in this paper as they are to be given by Professor Arambourg in a paper now in preparation. However, he has kindly permitted us to publish the measurements and their general appearance.

† It is extremely difficult to determine to which side a horn-core belongs because of the absence of cranial attachment. However, following careful consideration of the Olduvai specimens 1.53 and 2.53 and of the *S. giganteum* specimens (Falconer & Cautley, 1846–49; Falconer, 1868; Abel, 1904; Colbert, 1935), it has been decided by the authors that the posterior horns are probably directed laterally and backwards, and set at an angle of about 45° to a vertical and horizontal plane, when looked at from the front. In this way, the surface of the horn-core exhibiting the marked grooves becomes the antero-medial surface.

less than one-tenth of the mass of the posterior horn-cores) present equally large or larger grooves. Furthermore, along the line of these grooves, one does not find particularly significant nutrient foramina. In fact the foramina are very small and are found scattered over the whole surface of the horn-core, without any specific relationship to the grooves.

Thirdly, it would appear to be an unnecessary hazard for Nature to have exposed large vessels of great length in such an unprotected region as these curved horns.

The only apparent alternatives are ligamentous or cartilaginous attachments, and on the basis of the large grooves found in other bovids such as *Bubalus* (*Homoioceras*) where cartilage is known to surround the horn-core, it would appear reasonable to assume that these grooves are mainly for cartilaginous attachment, and possibly some of the smaller grooves (those posteriorly) may be for blood-vessels. This is contrary to Colbert's belief (1935) that the Giraffidae never developed a horn sheath during their evolutionary history, and that the hairy horns of the modern giraffe denote a primitive character that typified the various fossil forms.

(3) MANDIBLE

Making use of Makapansgat specimens M 553A, M 553B and M 553B[1], of which A and B[1] belong to the left side, and B to the right side of the same mandible (see Section II, chapter 3), the left half of the mandible was reconstructed by using the mirror image of M 553B. This resulted in a rather robust mandible (fig. 22) which was compared with the Hopefield fragment 4029, the Olduvai specimens 1, 6, 91, 92 and 392, the type specimen of *Libytherium maurusium* (Pomel, 1892) and the North African specimen 1950–1–1 (from Garet Ichkeul, Tunisia; in the Muséum d'Histoire Naturelle, Paris). These were further compared with the juvenile mandible M 539B from Makapansgat, and with data on modern giraffes. From this study the following observations and inferences were made:

(*a*) The total length of the jaw from the anterior alveolar border at symphysis menti to the posterior border of the alveolar socket of M_3 is not much longer in Sivatherines than in modern giraffes (5–15% difference).

(*b*) However, it is in the relative proportions of various significant regions of the mandible that Sivatheriinae differ from *G. camelopardalis*.

(i) The modern giraffe shows an absolute reduction of the length of the premolar-molar series (fig. 24) (for reduction of individual tooth sizes, see 'C. Dentition', *infra*).

The length of the premolar-molar series in proportion to the length of the jaw (as determined above) ranges from approximately 60 per cent in the fossil Sivatherines to 40 per cent in the modern giraffe.

(ii) The distance from the anterior border of P_2 to the posterior border of the symphysis menti is greater in the fossil Sivatherines than in the extant group:

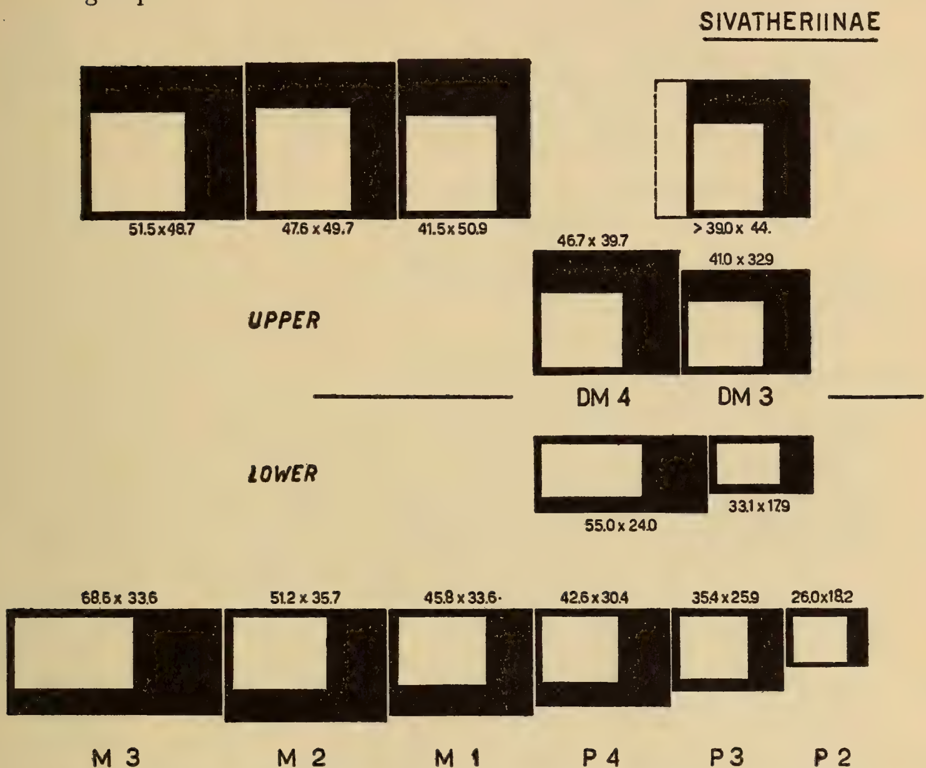

FIG. 24. Graphic representation of the relative ranges of dimensions (A–P and breadth) of adult and milk dentitions in the African Sivatheriinae (excluding F 39, MMK 3685). Mean dimensions are indicated.
Comparable ranges of the modern *Giraffa camelopardalis* are superimposed on those of the Sivatheriinae.

	mm.	*Percentage of total length*
1950–1–1 (North Africa)	*c.* 146	32%
Libytherium maurusium type	*c.* 100	
M 553A	*c.* 103	
G. camelopardalis	*c.* 78	19%

(iii) The distance between the anterior border of P_2 and the posterior border of the foramen mentale is much greater in the modern giraffe:

	mm.
M 553A	99
Libytherium maurusium Pomel—type specimen	100
G. camelopardalis	145

Comparing the data of (ii) with that of (iii) it is clear that foramen mentale is considerably anterior in relation to the position of the posterior border of the symphysis menti in the modern giraffe. In the Sivatherines, the foramen mentale is opposite the posterior border of the symphysis. This is confirmed by direct measurements: in Pomel's specimen of *Libytherium*, they are opposite each other; in Makapansgat 553A, the posterior border of the foramen is *c.* 9 mm. posterior to symphysis menti, while in *G. camelopardalis* this distance is *c.* 67 mm.

(iv) In the modern giraffe, the symphysis menti is considerably longer than that reconstructed in the Makapansgat specimen 553A when the measurement is taken from the position of the tip of the roots of the incisors. The measurements are 152 and approximately 100 mm. respectively.

(v) Following on observation (iv), if, in 553A, one considers the combination of the thickness of the symphysis (41 mm. at the anterior broken extremity; compared with that of *G. camelopardalis* at the same point, viz. *c.* 15 mm.), the shortness of the symphysis and the height of the body of the mandible (*c.* 65 mm.) at the level of the root of I_3, it would seem that the anterior canine-incisor alveolar arch must have been rather cup-shaped in the Makapansgat specimen, so that the teeth would have been embedded more vertically in the jaw than in the modern giraffe. This conclusion is supported by the appearance of the same region in *Hydaspitherium* sp. (A.M.N.H. 19684) (plate 50(*e*)), although it is unlikely that the Makapansgat specimen's teeth were as vertically embedded in the bony alveolus as those of *Hydaspitherium*. The Makapansgat *Sivatherium* canine-incisor row was probably in an intermediate position. Furthermore as the canine has not yet appeared and the canine-incisor arch appears to have 'no space' for it, considerable lateral expansion and increase in depth of the arch would have to take place to accommodate all the teeth. This specimen also indicates that the canine is the last tooth to appear in the dentition, as in the modern giraffe. (See also 'Appendix'.)

(*c*) Certain features concerning the breadth and height of the Sivatherine mandibles are also important:

(i) *Breadth.* The maximal breadth is found in the region between the anterior pillar of M_3 and the anterior pillar of M_1. Anterior to this region, the breadth decreases in a regular progressive fashion. In the juvenile mandible fragment M 539B, the maximal breadth is found opposite the 'talonid' of DM_4. This corresponds to the region opposite P_4 in the adult. If one now compares this with the breadth at this point in the adult, then it appears that a growth increase of about 30 per cent occurs between the two phases.

(ii) *Height.* The maximal height is (as expected) opposite the talonid of M_3, and anterior to this there is a progressive decrease towards the anterior

extremity of the jaw. Once again, if one compares the height in the juvenile at a point analogous to that in an adult specimen, then it appears that approximately a 100 per cent increase in growth occurs between the two phases.

(iii) The ratio of height to breadth is expressed as the *index of robusticity*. This is maximal in Sivatheriinae in the region of M_1–P_4, but the range varies tremendously between different specimens (e.g. 48·3 in *Libytherium* (=*Sivatherium*) 1950–1–1; 69·1 in Olduvai 91).

B. Postcranial Fragments

Postcranial fossil giraffid remains from Africa are very scarce. All the material studied by the authors comes from Olduvai.* Further specimens from various sites have been described by:

(*a*) Stromer (1907): a portion of the proximal extremity of a femur, a metacarpal, a fragment of calcaneum showing the fibular facet, and one phalanx: from Wadi Natrun, Egypt.

(*b*) Dietrich (1937): a metacarpal E. 122, from Olduvai gorge; and (1942): from Garussi-Korongo, a metacarpal numbered 1.29, a tibia fragment, a calcaneum, a few first phalanges, astragali numbered Vo 330.1 and Gar.K. 1.29, and 3 cubonaviculare numbered Vo 330.

(*c*) Arambourg (1947): a distal fragment of a scapula from Omo, Ethiopia.

(*d*) Bate (1951): a distal end of a radius and a distal portion of a humerus, from Abu Hugar, Sudan.

The non-metrical features of the Olduvai specimens which are distinctly different from those of extant giraffes, are:

first: in the cubonavicular, the posterior articular facet which articulates with the metatarsal is absent;

secondly, in the metatarsal the vertical anterior groove is much deeper and more scooped out;

thirdly, Arambourg (1947) noted that the spine of the scapula was attached to its dorsum nearer the glenoid cavity;

fourthly, Bate (1951) stated that the breadth of the shaft of humerus and radius relative to the distal end of those bones was much greater in Sivatherines than in the living giraffes.

Comparisons of the measurements of various bones available for study, and of those in the literature, produce a number of interesting features:

1. *Scapula*. There is an overall increase in the size of the scapula (table 42), the maximal breadth at the base showing the most marked differences from

* See also Appendix.

the modern *Giraffa*. There is also a difference in the distance between the root of the spine of the scapula and the glenoid fossa (which has already been noted as a non-metrical feature). It may be noted that the data for *S. giganteum* is very approximate to that of *S. olduvaiense* from Omo.

Measurements[1]	*Helladotherium duvernoyi* Gaudry, 1862	*Sivatherium olduvaiense*[1]	*Sivatherium giganteum* Falconer, 1868	*Giraffa*[1]		*G. camelopardalis*[2]		
				Male	Female	*2128*	*4949*	*4948*
Maximum breadth at the base, including coracoid process ..	150	167		132	126	162	154	151
Breadth at collum	100	116	110	80	75	99	94	83
Length of glenoid fossa	98	102	110–120	88	80	103	90	82
Breadth of glenoid fossa.. ..		80	82–100	78	76	85	83	73
Origin of the spine—glenoid fossa		66		118	114	127	109	132
Breadth of the fossa sub-spinosa, 10 cm. above the glenoid fossa	32	45						

TABLE 42. Scapula.

[1] After Arambourg, 1947. [2] Musée Royal du Congo Belge, Tervuren.

2. *Humerus*. There is a general similarity in the total length of the humerus of *S. giganteum* and *Giraffa*, although the breadth of the distal extremity and to a less extent of the mid-shaft region is much greater in *Sivatherium* (table 43, page 501).

3. *Radius and Ulna*. The data on the ulna is not sufficient to draw any conclusions (table 44).

	Olduvai *116*	*G. camelopardalis* (S.A. Mus., Cape Town) *17176*
Olecranon process to articular facet, along the superior border	184	143
Maximum height, olecranon process..	117	102
Maximum breadth, olecranon process	78	76
Maximum breadth, articular process	94	87

TABLE 44. Ulna.

In the case of the radius, although the maximal breadth of the distal extremity in *S. olduvaiense* and *G. camelopardalis* specimens is similar, a short distance above the distal end the breadth dimension indicates that in *G. camelopardalis* the shaft tapers very rapidly towards the middle of the shaft, while in *S. olduvaiense* the bone generally remains wide. There is very little difference in total length between *S. giganteum* (B.M. 39534) and *G. camelopardalis*, but the other Sivatherines appear to have a slightly shorter radius (table 45, page 502).

	? *Sivatherium olduvaiense* Abu Hugar (1)	*Sivatherium giganteum* (3)	*Giraffa camelopardalis* (2)	(3)	17176 S.A. Mus., Cape Town	2128 (4)	4949 (4)	6342 (4)	4948 (4)	4947 (4)
Diameter, articular surface of head ..		132–140				111–125	110–111	103–106	90–119	103–126
Total length		513		465	538	543	497	438	461	517
Proximal extremity: A–P		198				180	175	157	152	165
breadth		213				153	156	129	143	148
Mid-shaft: A–P		85		66	55	79	85	57	69	72
breadth		96		61	51	72	76	63	65	61
Shaft breadth, 'a short distance above distal extremity'	152		137		110	112	99	74	79	103
Distal extremity: condylar breadth ..	130		130		140	122	118	103	111	116
maximum breadth ..		183				139	141	122	127	141

TABLE 43. Humerus.

(1) Bate 1951. (2) id. (3) Our data from U.S.A. Museums. (4) Musée Royal du Congo Belge, Tervuren.

	Old. 115	*Helladotherium* (1)	*Hydaspitherium* A.M. 19770 (2)	*Sivatherium olduvaiense* Abu Hugar (3)	*Giraffa camelopardalis*							
							(5)					
					(3)	(4)	2128	4949	6342	4948	4947	17176 (6)
Proximal extremity												
Maximum breadth		143					143	136	124	128	135	154
Mid-shaft												
A–P						47	57	53	45	50	52	54
Breadth		74				62	75	69	60	64	67	83
Circumference		270					203	205		188	205	
Distal extremity												
Maximum breadth (at radial tuberosity)	122	130	115	140	105		148	129	115	116	130	136
Maximum A–P length	82						101	88	72	82	85	97
Shaft breadth 'a short distance above distal end'				135	87		91	93	80	80	90	94
Maximum breadth of proximal end of fragment	135											
Length without ulna						755	846	810	710	730	836	
Total length		592	c. 500				989	926	800	831	939	838

TABLE 45. Radius.

(1) Bohlin, 1926 (mean of 3 specimens). (2) Colbert, 1935. (3) Bate, 1951. (4) Our data from American Museums. (5) Musée Royal du Congo Belge, Tervuren. (6) S.A. Museum, Cape Town.

	Sivatherium giganteum B.M. 39·533	Old. 114	AM 19460 *Hydaspitherium* or *Bramatherium* (1)	AM 19460 *Hydaspitherium* or *Bramatherium* (1)	AM 29820 *Hydaspitherium* or *Bramatherium* (1)	*Helladotherium duvernoyi* (2)	*Sivatherium olduvaiense* Garussi Korongo (3)	*Sivatherium olduvaiense* E. 122 (3)	*Sivatherium giganteum* (3)	? *Libytherium* (4)	*Giraffa camelopardalis* (5)	S.A. Museum, Cape Town (17176)	2128 (6)	4949(6)	6342 (6)	4947 (6)
Proximal extremity																
Breadth			95	103	96	109		114	119	108		115	108	102	88	94
Superior articular surface: breadth	120												72			
A–P	69												72	66	58	62
Mid-shaft																
Breadth			58	61	56			70		55	48	59	60	53	46	49
A–P										40	47	62	58	56	46	48
Shaft about 60 mm. above distal extremity: breadth		79										87	78	61	52	62
A–P ..		42										58	53	45	38	43
Distal extremity																
Maximum breadth across condyles		105	100	98	96	100	118	111	119			114	116	102	89	93
Maximum breadth, lateral condyles (anteriorly) ..		51											49	48	42	44
Maximum breadth, medial condyles (anteriorly) ..	55	52					55	53	56				49	48	42	44
Breadth, inferior articular surface	120												103			
A–P length of condyles	55	54										75	69	65	57	63
Total length of metacarpal	355		432	398	427	420		290	348	360	659	757	760	744	657	666

TABLE 46. Metacarpal.

(1) Colbert, 1935.
(2) Gaudry, 1862.
(3) Dietrich, 1942.
(4) Stromer, 1907.
(5) Our data from U.S.A. Museums.
(6) Musée Royal du Congo Belge, Tervuren.

Note: AM 19460 are two left metacarpals with the same number.

	Old. 100	BM 39545 *Sivatherium giganteum*	BM 39546 *Sivatherium giganteum*	BM 39547 *Sivatherium giganteum*	*Giraffa camelopardalis* (1)	17176 S.A. Museum, Cape Town	2128 (2)	4949 (2)	6342 (2)	4948 (2)	4947 (2)
Proximal extremity											
Breadth including trochanter		190					183	177		166	176
Antero-posterior diameter of greater trochanter		102					94	81		66	67
Antero-posterior diameter of articular surface of head		76					73	71	61	64	67
Transverse diameter of articular surface of head		96					94	85	63	79	83
Mid-shaft: A–P					60	71	70	67	61	64	65
Transverse					51	72	57	58	49	54	55
Distal extremity											
Maximum breadth across condyles	161		162	193		171	154	142	132	136	143
Maximum breadth across medial condyle	72					76	72	67	60	67	70
Maximum breadth across lateral condyle	55					76	55	59	42	56	54
Maximum breadth across patellar condyle	78		74				84	85	80	79	83
Cord length of patellar condyle in the centre	109		104	119			95	95	84	88	86
Antero-posterior diameter: internally			218				209	202	185	185	200
externally			152				147	143	132	139	147
Total length of femur					492	539	590	539	485	492	550

TABLE 47. Femur.

(1) Our data collected at U.S.A. Museums. (2) Musée Royal du Congo Belge, Tervuren.

			Sivatherium giganteum					Giraffa camelopardalis						
	Old. 101	Old. 112	B.M.* 17072	B.M. 18482	B.M. 16611	B.M. 39548	B.M. 39549	(1)	17176 S.A. Museum, Cape Town	2128 (2)	4949 (2)	6342 (2)	4948 (2)	4947 (2)
Proximal extremity														
Maximum breadth ..			152	172	180					169	155	143	142	150
Maximum A–P			89	96	102					109	89	85	88	91
Mid-shaft														
Maximum breadth ..			69					62	81	80	73	63	68	69
Maximum A–P			48					49	62	62	65	42	54	56
Shaft 80 mm. above distal end:														
breadth	87								87	82	69	66	78	74
A–P	64								38	50	49	44	48	49
Distal extremity														
Maximum breadth ..	120	109	117			127	127		126	121	110	102	104	108
Maximum A–P	83	83	82			76	66		86	83	75	75	75	73
Total length			525					572	653	680	648	579	606	684

TABLE 48. Tibia.

* B.M. denotes British Museum (Nat. Hist.). (1) Our data from U.S.A. Museums. (2) Musée Royal du Congo Belge, Tervuren.

4. *Metacarpal.* There is a marked difference in length between the African Sivatherines and *G. camelopardalis*, the Sivatherines being 40–50 per cent shorter, and this also applies to other *Sivatheriinae*. It is here considered that the marked reduction in forelimb length in comparison with the modern giraffe previously noted, is mainly accounted for by the shortness of the metacarpal (table 46).

5. *Femur.* The available information indicates no marked difference between the extant giraffe and the extinct giraffid specimens. Unfortunately no information is available on the total length of the femur of the extinct genus (table 47).

6. *Tibia.* In only one Sivatherine (B.M. 17072) could the total length be measured, and it is approximately 10 per cent shorter than in the modern giraffe. No definite conclusion can be based upon this single observation. However the A–P length and the breadth are approximately the same in the two groups (table 48).

7. *Astragalus* (talus): The *Sivatheriinae* specimens have a much greater proximo-distal length, although the breadth is approximately the same. This increased length of the articular surface of the astragalus (table 49) may have been advantageous to the extinct short-legged animal for its efficient function, that is, to flex and to extend more powerfully for greater speed. It may also have been advantageous for more efficient weight-bearing.

	Sivatherium olduvaiense				*Hydaspitherium* or *Bramatherium* A.M. 19831[2]	*Sivatherium giganteum* BM 16.998	*Giraffa camelopardalis*	
	Old. 102	Old. 107	Vo. 330.1[1]	Ga.K. 39.1[1]			4949[3]	S.A. Museum, Cape Town 17176
Maximum proximo-distal length	113	112	130	112	·	124	99	93
A–P maximum length, medially	73	71					63	
A–P maximum length, laterally	64	63					60	
Maximum breadth, proximally	87	86			65	86	73	81
Maximum breadth, distally	c. 75	76					72	
Maximum articular breadth, proximally	74	73						
Maximum articular breadth, distally	c. 75	76	91	76				

TABLE 49. Astragalus.

[1] Dietrich, 1942. [2] Colbert, 1935. [3] Musée Royal du Congo Belge, Tervuren.

8. *Calcaneum.* No difference is noted between the extant giraffe and the extinct forms (table 50).

	Old. 103	Old. 108	A.M. 19831 *Hydaspitherium* or *Bramatherium*[1]	*Libytherium* Garet el Mulúk[2]	B.M. 39543 *Sivatherium giganteum*	4949 Tervuren[3]	17176 S.A. Mus., Cape Town
Maximum length	216	198	183			202	221
Maximum breadth	69	67			73	54	64
Maximum height, A–P tuberosity ..	69	*c.* 62			72	62	72
Maximum length, A–P opposite the fibular facet	89	91					
Body length from the superior border of the astragalus facet	131	*c.* 119				119	133
Minimum body breadth	39	42				31	42
A–P length of fibular facet (on its convex portion)	39	33		40		31	
Breadth of fibular facet	28	24		25		26	
Projection of heel					157		

TABLE 50. Calcaneum.

[1] Colbert, 1935.

[2] Stromer, 1907: ? *Libytherium* discovered in Garet el Mulúk; fibular articulation of a right calcaneum.

[3] Musée Royal du Congo Belge, Tervuren.

9. *Metatarsal.* As in the metacarpal, there is a tremendous reduction in the length of the metatarsal as compared with *G. camelopardalis.* In all other aspects, this bone of the Sivatherines is similar to that of the modern giraffe (table 51, page 508).

10. *Other tarsal and carpal bones.* From the data available no distinct differences may be observed between Sivatheriinae and *Giraffa* (tables 52, 53, 54).

	Olduvai 341
Maximum length	75
Maximum breadth	70
Maximum postero-lateral thickness ..	39

TABLE 52. *Os magnum.*

	Old. 106	Old. 111	Old. 314	? *Libytherium* (4)	*Sivatherium giganteum* (1)	*Helladotherium* (2)	AM 19831 *Hydaspitherium* or *Bramatherium* (3)	AM 19688 *Hydaspitherium* or *Bramatherium* (3)	AM 1977 *Hydaspitherium* or *Bramatherium* (3)	AM 19464 *Hydaspitherium* or *Bramatherium* (3)	*Giraffa camelopardalis* South African Museum, Cape Town	(5)	2128 (6)	4949 (6)	6342 (6)	4948 (6)	4947 (6)
Proximal extremity																	
A–P length, articular surface	81	84	.	.	94	86	.	.	.	.	94	.	77	83	75	69	73
Breadth, articular surface	93	95	.	88	96	86	78	82	81	68	101	.	89	85	73	72	79
Maximum A–P, medial articular surface	59	59	.	.	.	.	.	.	.	.	.	.	71	61	43	56	56
Maximum A–P, lateral articular surface	64	58	.	.	.	.	.	.	.	.	.	.	72	65	50	61	65
Maximum breadth across centre, medial articular surface	33	36	.	.	.	.	.	.	.	.	.	.	29	23	26	23	25
Maximum breadth across centre, lateral articular surface	40	c. 50	.	.	.	.	.	.	.	.	.	.	34	27	28	25	27
Shaft 60 mm. below proximal extremity																	
A–P length	67	65	.	.	.	.	.	.	.	.	77	.	65	63	52	57	65
Transverse breadth	65	72	.	.	.	.	.	.	.	.	65	.	57	59	50	51	54
Mid-shaft																	
Circumference	.	.	.	.	.	194	.	.	.	.	.	.	196	177	—	166	230
A–P length	.	.	.	.	.	.	.	.	.	.	61	46	61	55	50	48	50
Breadth	.	.	.	52	.	.	43	52	48	36	60	45	54	51	53	47	48
120 mm. above distal extremity																	
Maximum breadth	.	.	67	.	.	.	.	.	.	.	.	.	65	56	47	49	55
Maximum A–P	.	.	c. 60	.	.	.	.	.	.	.	.	.	48	44	38	41	44
Distal extremity																	
Maximum breadth, trochlea	.	.	109	.	.	.	83	89	89	72	100	.	90	89	81	85	87
Breadth, lateral trochlea	.	.	52	.	.	.	.	.	.	.	.	.	40	43	36	40	40
Breadth, medial trochlea	.	.	53	.	.	.	.	.	.	.	.	.	40	40	34	39	40
A–P length across trochlea laterally	.	.	63	.	.	.	.	.	.	.	.	.	62	58	52	56	58
A–P length across trochlea medially	.	.	61	.	.	.	.	.	.	.	69	.	60	57	51	56	57
Total length	.	.	.	355	415	446	434	431	450	369	802	670	775	760	662	700	785

TABLE 51. Metacarpal.

(1) Dietrich, 1942. (2) Bohlin, 1928. (3) Colbert, 1935. (4) Stromer, 1907. (5) Our data from U.S.A. Museums. (6) Musée Royal du Congo Belge, Tervuren.

	Old. 104	Old. 110	Old. 109	Vo 330 ? *S. olduvaiense*[1]	Vo 330 ? *S. olduvaiense*[1]	Vo 330 ? *S. olduvaiense*[1]	BM 39844 *Sivatherium giganteum*	17176 S.A. Museum, Cape Town *Giraffa camelopardalis*	4949[2] *Giraffa camelopardalis*
Maximum breadth (side to side) across centre ..	110	108	109	115	120	125	123	109	96
Maximum A–P length across tuberosity of navicular ..	106	106	95				127	98	98
Maximum length of navicular articular facet for cuneiform	55	55	50						69
Maximum breadth *idem* ..	37	37	35				38		31
Maximum length of cuboid facet for metatarsal ..	61	61	55						62
Maximum breadth *idem* ..	45	48	42				46		38

TABLE 53. Cubonaviculare (Scaphocuboid).

[1] Dietrich, 1942. [2] Musée Royal du Congo Belge, Tervuren.

	Olduvai 105	*Olduvai 110 A*
Maximum A–P length	68	59
Maximum breadth (side to side) ..	41	40
Maximum postero-lateral thickness ..	23	23

TABLE 54. Cuneiform.

C. DENTITION

A large series of teeth provides ample opportunity for determining typical features and variations of specimens from a particular site, and also for determining comparisons between dentitions from different sites. The characteristics of the Sivatheriinae teeth studied are:

I. NON-METRICAL FEATURES

(*a*) *Wear.* Those teeth which are either unworn or in the early stages of wear provide evidence that the teeth of the lower jaw are hypsodont, while the teeth up the upper jaw are, in general, at most mesodont, although F 39 is hypsodont. As in all other palaeontological studies on dentitions, the appearance of the various stages of wear may be most misleading if one has not had the unworn teeth available. In the Sivatherine dentition particularly, because of the great breadth of the tooth near the crown-root junction and consequently because of the varying amount of dentine present, and because of the fusion of the cones at different stages, the diagnosis of the teeth must be approached with caution. The large collection of Sivatherine teeth assembled from various

sites made it possible to establish a range of the stages of wear of the upper and lower dentition from the unworn teeth to teeth worn right down to the crown-root junction.

(*b*) *Slope and bulge of tooth surfaces.* Another important factor which requires careful consideration is that of the various degrees of slope of the buccal and lingual surfaces of the teeth from the crown-root junction towards the occlusal aspect. Furthermore, in relation to this slope, it has been observed that the profile of the enamel surface of the tooth may be either straight or it may have a rounded bulge in the region of the crown-root junction, quite apart from the cingulum. These variations are not only observed in teeth from the same site, but there may be variations in teeth of the same jaw. These features are seen particularly on the proto-hypocone (-id) enamel surface of the teeth.

In Old. 1, for example, the profile of the buccal surface on the posterior pillar of M_3 tends to be vertical and flat, while in the talonid it has a rounded bulge. Similar rounded bulges are observed in M_1 and P_4. Maximal bulging on the buccal surface is observed on the molars of Old. 6 and Hopefield 4029 (M_3). On the other hand, Hopefield 4028 tends to show a flattened vertical buccal surface, while another variation of the flattened effect is observed in M 553 B^1 where the profile is flat, but it is also sloping in a lingual direction towards the occlusal surface. The same effect is seen in Hopefield 4030. In the opposite direction, Old. 92 shows a very slight bulge above the cingulum, while most of the rest of the buccal surface is recurved so that a slight concavity faces buccally.

Similar variations in the slope and bulging of the enamel on the lingual surface are seen in the upper teeth, except that, where the surface tends to be straight, it slopes in a buccal direction and is not vertical. For example, Old. 109 has a slight irregularity of the enamel just below the cingulum, and the lingual surface slopes buccalwards towards the occlusal surface. In Hopefield 4023 there is a slight bulge below the cingulum and the lingual surface has a slight concavity as it slopes towards the occlusal plane. In Hopefield 4024, there is a rounded bulge below the cingulum and on the posterior pillar the concavity is quite marked. The maximum degree of this is seen in MMK 3685 where, immediately below the prominent cingulum, the lingual surface slopes at an acute angle markedly towards the occlusal surface in a buccal direction and also has a slight concavity facing towards the lingual side.

Specimen F 39 (of the Vaal River site) slopes at a marked angle from the cingulum towards the apex with a slight convexity lingualwards, but just beyond half-way towards the present occlusal edge, the surface tends to become slightly more vertical. It has been mentioned that the entire interior of the tooth is completely filled with breccia, and on radiographic examination vertical fracture lines can be seen, apparently being caused and filled by compressing breccia. This could be an explanation for some of the excessive bulging of the upper part of the lingual surface of the tooth. However, there are no distinct

cracks on the surface of the enamel, except for a small one on the anterior edge of the cingulum, and for some small cracks on the occlusal surface. This explanation is only a tentative one, and has not been used as a diagnostic criterion for discussion.

(*c*) *Central pit.* The variations observed in various teeth are purely due to the different degrees of wear and should be regarded as individual variations rather than in the light of taxonomical differences. Similar shapes and variations have been observed in specimens from all the sites in Africa.

(*d*) *Enamel.* The characteristic features and variations of the enamel of the Sivatherine dentition may be described as follows:

(i) *Rugosity*

As already mentioned, in the whole family of giraffids the enamel is rugose, and in the Sivatherines the rugosity is as variable as in other genera, namely from a fine pattern to a gross appearance. These variations are observed in the same specimen or in different specimens from the same site. Old. 6 for instance is finely rugose, while Old. 1 (from the same BK II locality) shows a coarse rugosity. Hopefield 4027 is finely rugose, while Hopefield 4023 (of the same jaw) is coarsely rugose. However, in the Sivatherine teeth in general, the enamel is thrown into far more numerous, closer-packed, vertical 'ridges' (each of which consists of a number of overlapping vertical spikes) than in *G. camelopardalis*, so that they tend to have a rougher appearance of the enamel than the modern giraffe. Even when the authors have described teeth as having a 'fine rugosity', the ridges—although less prominent—were still numerous and closely packed, quite distinct from the modern *Giraffa*, where they are fewer, shorter and separated from each other. The enamel pattern of the African fossil teeth is more akin to *S. giganteum* than the available examples of the other Sivatheriinae, in that in the latter the individual 'ridges' are less spiked.

(ii) *Cingulum*

A cingulum is practically always present on the buccal and lingual surfaces, varying from a thin, linear ridge to a rolled edge. The latter is usually found, when present, on the proto-hypocone (-id) aspect, while the former is typically found on the other aspect of the tooth. On the anterior and posterior surfaces, the cingulum is usually absent or deficient. Furthermore, there may or may not be a bulge related to the cingulum. On the other hand, just above (in lower) or just below it (in upper teeth) there may even be a concavity of the tooth surface (*vide supra*, (*b*)).

(iii) *Styles*

Elevations of the cingulum are commonly present in the form of inter-pillaric styles (entostyles and ectostylids), but this varies from tooth to tooth and jaw to jaw. The recording of the presence or absence of the styles may be

difficult because of the late stage of wear. Indeed, the styles vary in that they may or may not reach the crown-root junction. When they do not, they are usually present near the occlusal aspect of the tooth, so that in late wear the tooth presents the appearance of not possessing that particular style. This inference is drawn from the presence of the style on the unworn teeth.

The median costa is better developed on the anterior than on the posterior pillar, and in the lower teeth it seldom reaches the cingulum, occasionally ending as a rounded bulge above the cingulum. This effect is noticed in teeth from all the sites. The base of the metastylid usually commences about half-way up from the crown-root junction; consequently in late wear of the lower teeth, with the 'absence' of metastylid and median costa, the lingual surface of the tooth presents a rather flattened appearance. The mesostyle is always present as a persistent, well-marked, rounded ridge extending from the occlusal edge to the cingulum. The parastylid is usually ridged and slanting, being continuous at its base with the cingulum. The parastyle is always rounded, prominent and vertical, with its base continuous with the cingulum where it forms a bulge, and its apex tapering off to a point beyond the midpoint of the tooth. The entostylid is usually poorly represented, if present. However, the metastyle presents a fairly prominent bulge in the region of the cingulum, but it is relatively much smaller than the mesostyle or parastyle.

In comparison with the modern (brachydont) *G. camelopardalis*, the African Sivatheriinae show marked differences in respect of the relationship of the styles (-ids) to each other on the buccal (upper) and lingual (lower) aspects of the tooth. In the modern specimens, on the buccal aspect of the anterior pillars of the upper jaw, the parastyle meets the ridge-like prominent costa at an acute angle at its base. Posterior to the median costa the cingulum runs horizontal to the base of the prominent mesostyle. Posterior to the mesostyle, the buccal surface of the tooth is flattened and seldom presents a visible median costa or a metastyle. Consequently, the appearance of the buccal aspect of the upper tooth is that of an inverted trident.

In the lower teeth, each pillar presents a similar appearance, the anterior overlapping the posterior, the median costa being rather rounded, not only in an A–P convexity but also in a superior-inferior convexity, so that the occlusal tip of the metaconid and entoconid tend to bend over in a buccal direction. Behind each median costa there is a slight groove separating it from its respective stylid which is continuous with it about half-way up from the crown-root junction. Below that level, the lingual surface presents a rather continuous smooth bulging appearance.

In the Sivatheriinae, the styles and costae of the buccal surface of the upper teeth tend to be rather parallel to each other, the meeting of the base of the styles with the cingulum being in a broad U-shaped fashion. In the lower dentition, as mentioned above, the entostylids are poorly marked and the parastylids are prominent, which is the reverse of the situation in modern giraffes. Because the parastylid reaches the cingulum near the base of the

median costa, the lingual surface has a rather scalloped appearance and is not unlike the general appearance of the buccal aspect of the modern upper teeth.

(*e*) *Orientation.* In the Sivatheriinae, the lingual (lower) and buccal (upper) surfaces of the pillars present a generally smoother, flatter plane than those of the modern giraffes, because the surfaces of the Sivatherine pillars tend to lie more parallel to the longitudinal axis of the jaws than in the modern *Giraffa*, where the surfaces of successive pillars tend to overlap each other more acutely so that each pillar has the appearance of being independent of the next.

The talonid of the lower M_3 tends to be set at a variable angle to the longitudinal axis of the tooth: the axis of the talonid is nearly in line with that of the tooth (180°) in Old. 1, 3, 92, 120, Hopefield 4029, or at an angle of about 130° in Olduvai 6, F. 3656, Hopefield 4028A.

2. METRICAL FEATURES

Tooth	A–P			Transverse			Index		
	N	*M*	*Range of variation*	*N*	*M*	*Range of variation*	*N*	*M*	*Range of variation*
DM^3	1	41·0		1	32·9		1	80·2	
DM^4	1	46·7		1	39·7		1	85·0	
P^3				1	*44·*				
M^1	2	41·5	*38·* –*45·*	2	50·9	*47·* –54·8	2	122·5	121·6–123·5
M^2	3	47·6	46·3–*49·*	3	49·7	47·0–*54·*	3	104·1	96·1–112·4
M^3	5	51·5	44·0–*60·*	5	48·7	46·0–51·9	5	95·0	85·3–111·1
DM_3	1	33·1		1	17·9		1	54·1	
DM_4	1	55·0		1	24·0		1	43·7	
P_2	3	26·0		3	18·2	*17·*–19·8	3	70·2	65·4–76·2
P_3	3	35·4	34·0–36·3	3	25·9	*23·*–29·5	3	73·1	64·0–81·3
P_4	8	42·6	37·0–47·4	7	30·4	28·3–32·4	7	72·7	65·5–77·3
M_1	7	45·8	*44·* –*49·*	9	33·6	27·9–39·5	7	72·0	58·4–89·7
M_2	12	51·2	48·6–*55·*	10	35·7	33·2–40·2	10	70·0	62·8–76·0
M_3	9	68·6	59·0–*77·*	10	33·6	*31·* –39·7	9	49·6	41·9–60·1
I?	1	*21·*		1	18·4		1	87·6	
I?	2	22·3	22·0–22·7	2	17·5	17·4–17·6	2	88·3	76·6–80·0

TABLE 55. Transverse / A–P Index in the Sivatheriinae. The data exclude the dimensions of F.39, MMK 3685 and those teeth not definitely diagnosed as either M^2 or M^3.

(Italicized figures indicate approximations.)

The absolute A–P and transverse dimensions (table 55) in the Sivatheriinae are greatly in excess of those for modern *G. camelopardalis*. The calculation of the Transverse/A–P Index in both cases produces interesting observations:

(*a*) The African Sivatheriinae have a constantly (except for M^1) smaller Transverse/A–P Index than *G. camelopardalis* for the milk and the adult, in both upper and lower, dentitions. This indicates that the A–P length is relatively more reduced than the transverse breadth in the modern giraffe (fig. 24).

Tooth	Series	Upper		Lower	
		Mean	*Range of variation*	*Mean*	*Range of variation*
DM3	*Giraffa camelopardalis*[1]	86·9	78·8– 96·0	66·6	52·6– 78·2
	African Sivatheriinae[2]	80·2		54·1	
DM4	*Giraffa camelopardalis*	92·3	82·0–101·0	52·3	46·2– 58·0
	African Sivatheriinae	85·0		43·7	
P2	*Giraffa camelopardalis*	122·9	104·0–149·0	87·4	56·5–124·0
	Sivatherium olduvaiense[3]	110·0	100·0–119·0	78·0	
	African Sivatheriinae			70·2	
	Sivatherium giganteum[4]	113·0			65·4– 76·2
P3	*Giraffa camelopardalis*	125·1	101·0–157·0	91·9	68·8–115·0
	Sivatherium olduvaiense	128·0	126·0–130·0	74·0	65·0– 83·0
	African Sivatheriinae			73·1	64·0– 81·3
	Sivatherium giganteum	120·0			
P4	*Giraffa camelopardalis*	132·9	114·0–158·4	89·0	63·7–106·9
	Sivatherium olduvaiense	130·0	110·0–142·0	76·0	67·0– 88·0
	African Sivatheriinae			72·7	65·5– 77·3
	Sivatherium giganteum	129·0			
M1	*Giraffa camelopardalis*	103·9	88·0–119·4	78·6	67·9– 98·1
	Sivatherium olduvaiense	102·0	89·0–116·0	74·0	64·0– 81·0
	African Sivatheriinae	122·5	121·6–123·5	72·0	58·4– 89·7
	Sivatherium giganteum	107·0	100·0–115·0		
M2	*Giraffa camelopardalis*	106·8	91·6–128·0	77·8	69·7– 90·9
	Sivatherium olduvaiense	100·0		71·0	65·0– 83·0
	African Sivatheriinae	104·1	96·1–112·4	70·0	62·8– 76·0
	Sivatherium giganteum	97·0	94·0–100·0	69·0	66·0– 72·0
M3	*Giraffa camelopardalis*	107·4	91·5–122·4	61·2	47·6– 76·4
	Sivatherium olduvaiense	106·0	102·0–108·0	50·0	49·0– 51·0
	African Sivatheriinae	95·0	85·3–111·1	49·6	41·9– 60·1
	Sivatherium giganteum	93·0	92·0– 94·0	49·0	48·0– 51·0

TABLE 56. Tr. / A–P index of the different types of teeth in the extant *Giraffa camelopardalis*, and in several series of Sivatheriinae.

[1] Calculated from data from U.S.A. Museums; see Section I, chapter 5.
[2] From the African Sivatheriinae presently described.
[3] Calculated from data, according to Dietrich, 1937, 1942.
[4] From data according to Colbert, 1935.

(*b*) These observations have also been made for other Sivatheriinae on the basis of the data of Dietrich (1937, 1942) for material from Olduvai, and of Colbert (1935) for *S. giganteum* from the Siwaliks. Their results fall into the range of variation of the African Sivatherine material here described (table 56). However, the index for Dietrich's and for Colbert's M^1 fall outside the range: this peculiarity, linked with the exceptional result obtained for M^1 from the other African material, suggests that the sampling of the M^1 presently described has not been representative. Table 57 illustrates, for the various collections, the

difference of their respective index from that of *G. camelopardalis*: it averages 10 units in the case of the African Sivatheriinae.

Tooth	UPPER			LOWER		
	Sivatherium olduvaiense[1]	African Sivatheriinae[2]	*Sivatherium giganteum*[3]	*Sivatherium olduvaiense*[1]	African Sivatheriinae[2]	*Sivatherium giganteum*[3]
DM3		−6·7			−12·5	
DM4		−7·3			−8·6	
P2	−12·9		−9·9	−9·4	−7·2	
P3	+2·9		−5·1	−17·9	−18·8	
P4	−2·9		−3·9	−13·0	−16·3	
M1	−1·9	+18·6	+3·1	−4·6	−6·6	
M_2	−6·8	−2·7	−9·8	−6·8	−7·8	−8·8
M_3	−1·4	−12·4	−14·4	−11·2	−11·6	−12·0

TABLE 57. Absolute difference between the respective Tr. / A–P index of several collections of Sivatheriinae and that of *G. camelopardalis*.

[1] Data from Dietrich, 1937, 1942.
[2] African material here described.
[3] Data from Colbert, 1935.

(*c*) The significance of the difference of means between the fossil Sivatherines and *G. camelopardalis* has been statistically tested, and has proved 'highly significant' for DM_3, P_2, P_3, P_4, M_1, M_2, M_3, M^3: 'significant' for DM_4; 'not significant' for DM^3, DM^4 and M^2.

(*d*) A further step was to estimate the Tr./A–P Index in other fossil genera and subfamilies, namely, *Palaeotragus*, *Honanotherium* and *Orasius* (data according to Bohlin, 1926). A similar low index was obtained (see table 58). Consequently it appears that the same evolutionary trend of a reduction greater for length than for breadth has been demonstrated by different phyla in the giraffid family.

Tooth	*Giraffa camelopardalis*[1]	*Palaeotragus*[2]	*Honanotherium*[2]	*Orasius*[2]	Sivatheriinae[3]
DM^2	96·68 (35)	70·84 (2)	71·91 (4)		
DM^3	86·96 (38)	78·51 (6)	80·65 (2)		80·2 (1)
DM^4	92·28 (38)	90·82 (7)	95·53 (2)		85·0 (1)
DM_2	64·44 (37)	63·14 (5)	58·82 (1)		
DM_3	66·58 (36)	66·15 (6)	61·90 (1)		54·1 (1)
DM_4	52·30 (37)	60·03 (6)	59·37 (1)		43·7 (1)
P^2	122·86 (117)	100·08 (7)	102·54 (2)	80·95 (1)	
P^3	125·12 (120)	107·73 (9)	115·41 (3)	97·95 (2)	
P^4	132·86 (116)	124·35 (9)	134·77 (4)	109·76 (3)	
M^1	103·91 (138)	108·37 (13)	106·11 (4)	101·85 (2)	122·5 (2)
M^2	106·79 (130)	105·01 (13)	109·38 (8)	97·73 (3)	104·1 (3)
M^3	107·44 (121)	101·62 (12)	108·39 (6)	91·63 (3)	95·0 (5)
P_2	87·41 (109)	83·90 (5)	77·77 (1)		70·2 (3)
P_3	91·95 (124)	84·47 (9)	77·59 (2)	70·00 (1)	73·1 (3)
P_4	89·02 (127)	82·03 (10)	82·97 (2)	77·27 (1)	72·7 (7)
M_1	78·59 (143)	82·35 (4)	74·28 (1)	65·38 (1)	72·0 (7)
M_2	77·77 (135)	79·45 (13)	87·09 (1)	69·23 (1)	70·0 (10)
M_3	61·21 (121)	50·41 (9)	55·23 (3)	52·77 (1)	49·6 (9)

TABLE 58. Transverse / A–P index in fossil and extant Giraffid teeth.
Between parentheses ( ) is the number of specimens from which the mean has been calculated.

[1] Specimens from U.S.A. Museums (see Section 1, chapter 2).
[2] Bohlin, 1926.
[3] African material here described.

Index	*Giraffa camvlopardalis*[1]	*Honanotherivm*[9]	*Helladotherium*[2]	*Palaeotragus*[2]	*Orasius*[2]	African Sivatheriinae[3]
Length DM^2 / Length DM^3	75·38 (36)	95·60 (1)	83·90 (3)	77·83 (3)		
Breadth DM^2 / Breadth DM^3	83·94 (36)	89·50 (1)	76·16 (3)	75·85 (6)		
Length DM^3 / Length DM^4	92·93 (38)	87·50 (1)	88·40 (4)	90·95 (8)		88·60 (1)
Breadth DM^3 / Breadth DM^4	87·47 (38)	76·60 (1)	79·54 (5)	80·00 (9)		82·90 (1)
Length P^2 / Length P^3	91·94 (122)	97·85 (2)	98·60 (2)	93·89 (10)	95·40 (1)	
Breadth P^2 / Breadth P^3	91·28 (106)	88·80 (2)	89·50 (1)	86·10 (8)	85·00 (1)	
Length P^3 / Length P^4	101·60 (121)	97·95 (2)	104·95 (2)	101·45 (10)	110·00 (1)	
Breadth P^3 / Breadth P^4	95·02 (109)	84·90 (2)	90·40 (2)	84·66 (9)	85·30 (1)	
Length M^1 / Length M^2	93·12 (127)	95·31 (6)	88·10 (2)	89·43 (13)	92·90 (1)	82·00 (11)
Breadth M^1 / Breadth M^2	91·44 (121)	94·13 (3)	86·95 (2)	92·41 (11)	96·30 (1)	97·60 (1)
Length M^2 / Length M^3	104·13 (122)	88·41 (6)	104·55 (2)	98·45 (12)	84·80 (1)	92·80 (2)
Breadth M^2 / Breadth M^3	104·12 (116)	104·18 (5)	113·01 (11)	103·71 (12)	100·00 (1)	103·20 (2)
Length P_2 / Length P_3	80·40 (109)	78·20 (1)		77·18 (6)		77·00 (2)

Breadth P_2 / Breadth P_3	76·70 (110)	77·80 (1)		75·88 (6)		67·50 (2)
Length P_3 / Length P_4	90·23 (123)	92·35 (2)		87·90 (11)	90·80 (1)	88·70 (2)
Breadth P_3 / Breadth P_4	93·17 (116)	86·20 (2)		87·47 (10)	82·20 (1)	90·00 (2)
Length M_1 / Length M_2	93·76 (135)	94·50 (1)		94·56 (5)	100·00 (1)	90·80 (4)
Breadth M_1 / Breadth M_2	94·38 (134)			98·94 (12)	94·20 (1)	98·60 (6)
Length M_2 / Length M_3	79·58 (125)	66·00 (1)		67·24 (11)	72·20 (1)	72·70 (7)
Breadth M_2 / Breadth M_3	101·34 (120)	108·00 (1)		103·37 (12)	94·70 (1)	104·20 (4)

TABLE 59. Dental Index in extant *G. camelopardalis* compared with that of several extinct giraffid groups. Between parentheses ( ) is the number of specimens from which the mean has been calculated.

[1, 2, 3] See Table 58.

Two hypotheses may be advanced to account for the relatively increased breadth of the modern teeth and the reduction in length of the total molar-premolar series relative to the length of the jaw (see Section III, chapter I, A):

(i) The maximal contact wear between contiguous teeth was observed in the fossil lower jaws, especially in M_1 and P_4, far more than in the modern jaws where it is only occasionally observed. It is also in the lower jaw that the greater length reduction has occurred: this may have been an attempt to compensate for the 'impacted' effect of the over-crowded teeth and in order to accommodate them.

(ii) The fact that the teeth decreased more in length than in breadth may be explained by the fact that there is a selective advantage in a broader grinding surface for the side-to-side masticatory movements.

Owing to the lack of a complete maxilla, one is confronted with a problem to which an answer cannot yet be supplied, namely, the disproportion between the respective length reduction in the total upper and lower dentitions.

(*e*) *Dental index:* The dental index (Section I, chapter 5) is calculated to be usually smaller in the fossil genera (*Sivatherium*, *Honanotherium*, *Helladotherium*, *Palaeotragus*, *Orasius*) for length and breadth (with constant exceptions in the dental breadth index for M^1/M^2, M_1/M_2 and M_2/M_3 (table 59). Consequently, in the dental series, a particular posterior tooth, if compared with the tooth immediately anterior to it, is relatively longer in the fossil genera than in the modern giraffe material. This indicates that the reduction in the length of individual teeth has been greater in respect of the more posterior teeth.

CHAPTER 2

DIAGNOSIS OF AFRICAN FOSSIL GIRAFFID GENERA AND SPECIES

Colbert (1935) has modified the classification of the family Giraffidae of Pilgrim (1911), Bohlin (1926) and Matthew (1929) along sound lines. Because of the limitation of the African material, it is not the purpose of this paper to criticize this classification which is generally acceptable as a basis of discussion:

Giraffidae

Large, ruminating artiodactyls, with heavy, rugose cheek teeth. The skull may or may not have horn-cores, but if they are present they show a great variety of development. Bones of cranial roof pneumatic. Lateral metapodials and digits atrophied.

Palaeotraginae

Primitive, medium-sized giraffids, having as a rule one pair of supra-orbital, frontal horn-cores. There may be a second pair of horn-cores at the

anterior extremities of the frontal. Horn-cores in the form of simple tines, well developed in the males, feebly developed or absent in the females. Skull usually elongated, dolichocephalic.

Cheek teeth brachydont, with moderately coarse sculpture on the enamel. Neck and limbs slightly elongated.

Genera: *Palaeotragus* *Achtiaria* (syn. with *Palaeotragus*).
Giraffokeryx
Okapia
Samotherium *Alcicephalus*, *Chersonotherium*, *Shanshitherium* (syn. with *Samotherium*).
Propalaeomeryx, *Progiraffa* } Of doubtful status; placed here provisionally.

Giraffinae

Large giraffids, with a moderately brachycephalic skull. Horns variously developed, being on the parietals and frontals, and in *Giraffa* a single median horn is also present, located on the nasals. Horn-cores rounded or flattened on the ends and covered with hair. Skull roof with highly developed sinus cavities.

Cheek teeth brachydont, with heavily rugose enamel. Limbs and neck greatly elongated.

Genera: *Giraffa*
Orasius
Honanotherium

Sivatheriinae

Gigantic giraffids, with large, heavy, brachycephalic skulls. Horns variously developed, being of frontal and parietal origin. Skull roof with large sinus cavities.

Cheek teeth moderately hypsodont, with heavily rugose enamel. Limbs not elongated but very heavy. Body heavy.

Genera: *Sivatherium*. *Indratherium* (syn. with *Sivatherium*)
Bramatherium
Hydaspitherium
Helladotherium
Vishnutherium
Griquatherium
Libytherium

On the basis of the above definitions, the Hopefield giraffids which form a homogeneous group (except for one tooth, 3345, which has already been referred to *G. ?camelopardalis*, see Section II, chapter 4) may be assigned to the Sivatheriinae. Although descriptions and diagnosis of the different genera of Sivatheriinae have been published, no diagnosis (*per se*) is available in the literature for *Vishnutherium*, *Griquatherium* or *Libytherium*, yet the features of the generic types are briefly commented on. *Helladotherium* is hornless and may be excluded from consideration of the Hopefield material.

Colbert (1935) proposes the diagnoses for *Sivatherium*, *Bramatherium* and *Hydaspitherium* as follows:

Sivatherium

A gigantic Pleistocene giraffid, with four horns in the male, an anterior conical pair, arising from the frontals, and a posterior, palmate pair situated on the parietals. As in the other gigantic Siwalik giraffids there are deep pits in the temporal fossa for the temporal muscles, and on the supraoccipital for the neck muscles. The face is very short, the nasals being retracted and strongly curved. The teeth are large, with rugose enamel. Body and limbs heavy, limbs not elongated.

Bramatherium

A gigantic Upper Tertiary giraffe having four horns, two of which grow up from the fronto-parietal region, and two of which extend laterally from the parietals. Face short, with nasals considerably retracted. A large groove occupies the parietal region just below the horn-core bases as an accommodation for the temporalis muscles. Deep pits are located in the supraoccipital for the heavy neck muscles. Teeth large and heavy, with rugose enamel. Limbs and body presumably heavy and massive.

Hydaspitherium

A gigantic giraffid with two horn-cores, fused at their bases into one solid mass, on the frontal-parietal region. The face is short, the nasals retracted. There is a large parietal or temporal groove below the horn-core for the accommodation of the temporal muscles. Teeth large, quadrate, with rugose enamel. Limbs massive and not extraordinarily elongated.

From the above diagnoses it can be seen that these forms overlap considerably, except in respect of their horns. The brief descriptions, however, are not found sufficient for positive determination of the Hopefield material, and consequently various other details of the material were compared with other collections, and it became obvious that the Hopefield specimens had greatest affinity to *Sivatherium olduvaiense*, to which the homogeneous Hopefield group is assigned without hesitation.

It has already been stated (Section II, chapter I) how Hopwood (1934) first diagnosed his original Olduvai material as *Helladotherium olduvaiensis* on the basis of some teeth and a partial hind-limb. Later (Hopwood, 1936), with the discovery of 'palmated antlers', the material was referred to *Sivatherium*: Hopwood stated however that 'the antlers are not so widely palmated as in *S. giganteum*, and terminate in a recurved point'; hence, the specific determination of *S. olduvaiense*.

It is now necessary to discuss and compare the material from the various sites in Africa in regard to this diagnosis.

I. OLDUVAI AND OTHER EAST AFRICAN SITES

All the specimens from Olduvai form a homogeneous group, both from a non-metrical and metrical point of view. As a result of the fact that *Orangiatherium vanrhyni*, which was discovered and actually named earlier than *Sivatherium olduvaiense*, has now been invalidated and referred to a subspecies of *S. olduvaiense* (*vide infra*), the question of generic or specific priority does not arise any more. Consequently all the Olduvai material and the specimens related to it are assigned to *S. olduvaiense*. To this group are also referred the two specimens marked 'Marsabit Road', from Kenya.

II. LIBYTHERIUM MAURUSIUM POMEL, 1892

On the basis of a fragmented mandible containing M_3–P_4 and a part of P_3 (plate 53), Pomel proclaimed a new genus and species which he envisaged to be within the Sivatheriinae, but he does not state clearly his reasons for creating the new genus. In 1947, Arambourg assigned giraffid teeth and a scapula from Omo to *Sivatherium olduvaiense*, and in re-discussing Pomel's material, he gave as reasons for separating *Libytherium* from *Sivatherium*: (1) the premolar series is reduced; (2) P_4 has an open inner wall where paraconid and metaconid remain separated; (3) the parastylid is very developed in P_4 and in the three molars.

Furthermore, in a right mandible (1950–1–1, Muséum d'Histoire Naturelle, Paris) from Garet Ichkeul, St. Arnaud (Tunisia) (plate 52(*a*)), diagnosed as *Libytherium maurusium*, the above features are absent, and in all respects this mandible is identical to specimens at a similar stage of wear from Olduvai (Old. 6, for instance).

Arambourg (1948(*a*)) stated that excavations at St. Arnaud provided new fragments of *Libytherium*, and in particular characteristic 'antlers' ('ramures') of the Sivatheriinae. Comparison of the non-metrical and metrical features of these horn-cores (1948–1–2, 1948–1–1) (plate 51), as well as of a third (unnumbered) specimen (plate 52(*b*)) (the cast of which has been made available by the kindness of Professor C. Arambourg and Professor J. P. Lehman) with posterior horn-cores from Olduvai, Hopefield and Tierfontein, indicates a distinct similarity of all the specimens and it is considered that they must be referred to *Sivatherium olduvaiense*.

However, on the basis of Arambourg's criteria for the *Libytherium maurusium* dentition, there is no doubt that the specimen on which he based these facts is decidedly different, not only from *Sivatherium olduvaiense*, but also from specimen 1950–1–1 from Garet Ichkeul. Furthermore, these criteria are so distinctive, especially the primitive nature of P_4, that it is necessary to divide the North African material into *Libytherium maurusium* for the type specimen, and *Sivatherium olduvaiense* for the horn-cores, mandibles and other similar specimens (e.g. specimens 1948–1–1, 1948–1–2, 1949–2–937, 1949–2–938, 1949–2–725, 1931–45, 1931–8, 1931–8–110, 1950–1–90, 1950–1–1 in the Muséum d'Histoire

Naturelle, Paris) mostly as yet unpublished but examined by one of us, and to be published shortly by Professor C. Arambourg. However, it may yet become necessary to equate *Libytherium* with the rather widely varying genus *Sivatherium*.

III. GRIQUATHERIUM

Three specimens have been assigned to this genus: MMK 3685 and M 553B[1] are described as *G. cingulatum*, and F.39 as *G. haughtoni*.

(*a*) The Makapansgat specimen M 553 B[1] has been referred to *G. cingulatum* by Cooke and Wells (1947). They state that from an examination 'it would appear that [these] lower teeth are of the correct size and form to belong to Haughton's species though probably to a smaller individual'.

From the range of variation obtained by the authors (see tables 39, 40) it is quite clear that the Makapan teeth fall within the range of the East African and the Hopefield material. In fact the breadth of M_2 of M 553 B[1] is the smallest in the range. The general form and character, which Cooke and Wells considered to be distinctive of the specimen, are identical to *Sivatherium* specimens at a similar stage of wear, e.g. Olduvai, specimen 92. Consequently, there is no basis, either metrical or non-metrical, for separating M 553 B[1] from *Sivatherium olduvaiense*; this conclusion is further confirmed by the other Sivatherine material from Makapansgat described above, which are also referred to this genus and species.

Although the lingual surface of P_3 of M 553 B is 'open' as in Pomel's P_4 (*Libytherium maurusium*, type), there is still a considerable amount of the crown hidden by the bone, the tooth having just started to erupt. Because this 'open' appearance is confined to the upper portion of the tooth, it is estimated that it would resemble Old. 6 for instance, at an equivalent stage of wear. Furthermore, the teeth are much larger than those of the Pomel specimen, and are identical to *S. olduvaiense*. The former point mentioned was the only possible doubt the authors had concerning the determination of the Makapan M 553B specimens as *S. olduvaiense*.

(*b*) MMK 3685 (*G. cingulatum* Haughton 1922): The designation of this tooth presents a number of problems. From the description of this specimen (*vide* Section II, chapter 2), the following characteristics appear to differ from those of other African specimens: (1) great breadth of the tooth; (2) relative difference in breadth of the two pillars; (3) marked cingulum forming an unusually developed proto- and hypostyle; (4) prominence of the meso- and parastyle; (5) the acute angulation of the lingual surface (in profile) to the crown-root junction; (6) the abnormal length of the posterior pillar relative to the anterior. Some, if not all, of these features may be found individually in single specimens, often in a modified form. But the above features appearing together produce this peculiarly gross form. It is certainly a Sivatherine, and it has been compared to both *Hydaspitherium* and *Sivatherium*, and it has been suggested that it is possibly even nearer *Hydaspitherium* (Bohlin, 1926; Colbert,

1935; Cooke, 1949; Singer, 1954). Nevertheless, those features in common with *Hydaspitherium* are also exaggerated and it is more massive. On this basis, and because *Hydaspitherium* has not yet been discovered in Africa, it is considered reasonable to refer this single, very worn tooth to *Sivatherium* with which it essentially shares most features.

As regards the specific designation, although it bears a resemblance to F 2993, Old. 4 and 109 from Olduvai, the latter specimens are closer to Hopefield 4027, 4023 and 4024 and share the same range of variation. MMK 3685 tends to fall just outside this group, but it is a single specimen and no other material from Africa can yet be referred to it. Furthermore there are no associated skeletal remains of the same animal. It is probable that if Cooke and Wells had all the comparative material from Olduvai and Hopefield available in 1947, they would not have referred M 533B[1] to *G. cingulatum*. It could almost be considered as a *nomen vanum*, but in the above discussion its generic nature is established. Consequently in the present state of our information it would be preferable to retain *cingulatum* as a species of *Sivatherium*.

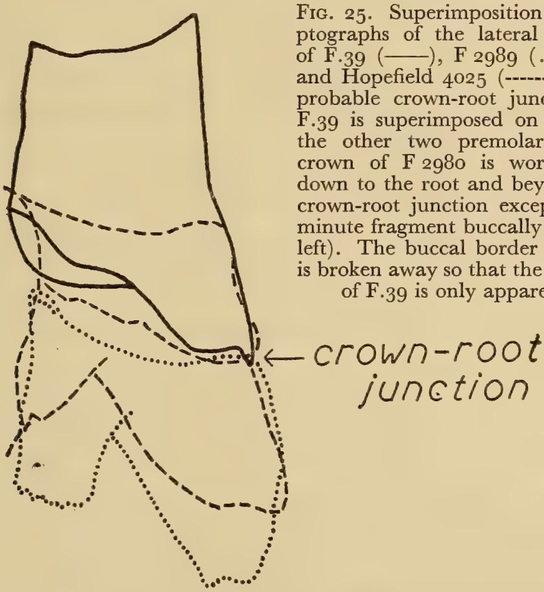

FIG. 25. Superimposition of dioptographs of the lateral aspects of F.39 (——), F 2989 (......), and Hopefield 4025 (------). The probable crown-root junction of F.39 is superimposed on that of the other two premolars. The crown of F 2980 is worn right down to the root and beyond the crown-root junction except for a minute fragment buccally (on the left). The buccal border of 4025 is broken away so that the overlap of F.39 is only apparent.

(*c*) F 39 (*G. haughtoni* Cooke 1949): In the description of the tooth (Section II, chapter 2), statistical data was presented to support the hypothesis that this specimen is not a lower molar. This may be strengthened further by comparing the specimen with known upper Sivatherine premolars, for example F 2989 and 4025 (fig. 25). It would not be difficult to reconstruct three roots on the specimen; its base fits perfectly and directly on F 2989, which is worn right down to the crown-root junction. The A–P axis and the breadth of F 39 are smaller than those of F 2989 and 4025. Comparison with other upper

premolars indicates that from the points of view of other dimensions and of general appearance, F 39 may be considered as an upper premolar, probably P^3. The major objections to this diagnosis are:

(1) the extreme hypsodonty of the specimen, and

(2) the bulge on the lingual surface just below the crown-root junction.

The latter may be partly explained by the X-ray appearance (*vide supra*) and partly by individual variability. In connection with the hypsodonty, it is unfortunate that the available upper premolars of all the Sivatherine specimens are so few, and also that they are in advanced stage of wear. Consequently an adequate range of variation cannot be obtained for comparison. However, if one attempts to reconstruct available specimens such as 4025 then it would appear that the hypsodonty of F 39 may be equated. An unsatisfactory feature of this diagnosis is that the upper molar Old. 109—an almost unworn M^3—measures only 47·0 mm. Even if this difference of 20 mm. (the teeth are at approximately the same stage of wear) were decreased by a greater number of specimens widening the ranges of variations, there would still be a significant difference in height. However, it is important to consider the dentition as a whole in the skull. If one examines the fairly complete *S. giganteum* skull (15283) in B.M.N.H., it is seen that there is a distinct downward convexity in a mesio-distal direction between P^2 and M^3. Furthermore it is seen that P^4 is approximately at the summit of the convexity and consequently it is expected that P^3 and P^4 should be more hypsodont than M^3. It is thus reasonable not to exclude this specimen from *S. olduvaiense* only on the basis of its hypsodonty, particularly because it is a single specimen and the comparable series is small. However, it is felt that there are sufficient grounds to tentatively place the specimen in a subspecies, namely *haughtoni*.

Because Cooke (1949) compared this specimen with *Sivatherium* (*Griquatherium*) *cingulatum*, it is necessary to comment on his remarks. The bases of distinction drawn by Cooke for separating F.39 from *Sivatherium* (*Griquatherium*) *cingulatum* are not considered to be sufficient for a specific difference. First, the central pit of a tooth is so variable that it cannot be used for differentiating two species. Secondly, the small piece of cingulum remaining visible on the tooth indicates that the cingulum *is* marked. For these reasons, and because of the fact that these two specimens come from the same area, although the exact localities of their discovery are unknown, the probability that these two unusually gross teeth belong to the same species is not insignificant. This independent conclusion supports the view stated above that *S. cingulatum* could be considered on a subspecific level of *S. olduvaiense*. Further discoveries are required to resolve this problem.

IV. MAKAPANSGAT

It has been stated above (111 *a*) that specimens M 553 B^1 (*G. cingulatum*) and M 553 B have now been referred to *Sivatherium olduvaiense*. This also holds

good for M 553 A and the other Sivatherine material described and discussed above (Section 11, chapter 3).

V. ORANGIATHERIUM

The horn-cores mentioned by van Hoepen (1932) show all typical features of those of *S. olduvaiense*, from North Africa, Olduvai and Hopefield. However, it has been mentioned that it is distinctive only for its extremely grooved appearance on its antero-medial convex surface. There are slight variations in regard to the position of the knobs, but these are known to be highly variable features.

The four teeth from the same site (C 426 A, B, C and D)—two of them showing contact surfaces, and all four presenting the same degree of wear—almost certainly belong to one individual. Lack of accurate information concerning their discovery makes it impossible to associate definitely the teeth with the horn-cores. However, it would seem likely that they belong to the same species, if not the same individual, because they are derived from a single farm. Furthermore, van Hoepen (1932) stated that the teeth most likely belong to the horns. From a morphological point of view, C 426 A, B, C and D are identical to those extreme stages of wear in the *S. olduvaiense* material, but there are some important metrical differences. C 426 A is longer and broader than the M^3 of either Hopefield or Olduvai. Although the length of the anterior and posterior pillar do not differ much from *S. olduvaiense*, the great enlargement of the metastyle in C 426 A provides it with a great increase in length. The metastyle has been noted to be a well-developed character: but it is even more prominent in this specimen than in MMK 3685.

Owing to the fragmentary nature of B, C and D, nothing can be said of the styles, but the length of the pillars, as for C 426 A, fall beyond the dimensions of the few M^3 available.

Unfortunately, the teeth are in extreme stages of wear, even the bases of the roots showing signs of attrition, and little more can be said of the distinctive features of these teeth.

Because the horn-cores are so similar to those of *S. olduvaiense* (in which some specimens have marked grooves) and because the few morphological features of the dentition are also similar to *S. olduvaiense*, the authors hesitate to provide a new species only on the basis of dental size, especially in the light of the fact that so few M^3 are available and that the growth pattern in these few teeth appears to show a marked tendency towards 'abnormalities'.

It would appear that, because of the wide range of variation within the species, gross dental metrical exaggerations should be considered on a sub-specific level until clear criteria for specific differences can possibly be elicited in specimens yet to be discovered. These dental maxima may only be ecological variations, but, on the other hand, future evidence may indicate these maxima to be of a specific nature.

Consequently, even though criteria for a 'subspecies' in fossil material are difficult to elicit and clarify, it is proposed to refer the specimens of *Orangiatherium vanrhyni* to a subspecies of *Sivatherium olduvaiense*. The question of priority which would normally arise both as regards genus and species, falls away as van Hoepen's terminology is invalidated under Article 25(*c*) of the International Code of Zoological Nomenclature. To link the specimens with discoverer, it is proposed to designate them *Sivatherium olduvaiense vanhoepeni*.

The plaster cast representative (C.1492) from Florisbad appears to fall within the range of variation of *Sivatherium olduvaiense*.

VI. ?CORNELIA, ?FLORISBAD

The two milk molars marked B_1 and B_2 are Sivatherine in form and size but nothing is recorded of the site of their discovery. Because of lack of comparative deciduous teeth and because of the fact that more than one subspecies might be represented in the Orange Free State, the authors have decided to refer these two teeth to an indeterminate subspecies of *Sivatherium olduvaiense*.

Concluding Note on Taxonomy

It is now necessary, on the basis of the above discussion, to modify Colbert's classification (1935) of the genera of the Sivatheriinae as follows:

Sivatherium syn. *Indratherium*
Bramatherium
Hydaspitherium
Helladotherium
Vishnutherium
Libytherium

As far as the African fossil Sivatherine material is concerned, the following genera, species and subspecies are recognized from 22 sites extending from North Africa to the southern tip of South Africa:

Libytherium maurusium Pomel 1892
Sivatherium olduvaiense Hopwood 1934
Sivatherium olduvaiense haughtoni
Sivatherium olduvaiense vanhoepeni, subsp. nov.
Sivatherium olduvaiense subsp. indet.
Sivatherium cingulatum

CHAPTER 3

THE FAUNAL RELATIONSHIPS AT THE AFRICAN SIVATHERINE SITES

All the available data concerning the fauna identified at the various African sites (figs. 17a, 18, 23) where Sivatherines are known to have been

Genera	Wadi Natrun	Garet Ichkeul	St. Arnaud	Omo	Kanam	Olduvai I	Olduvai II	Olduvai III	Olduvai IV	Serengeti	Olorgesailie	Makapansgat	Hopefield	Florisbad	Cornelia
**Libypithecus*	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
**Simopithecus* incl. *Gorgopithecus*	.	.	.	.	.	x	x	x	x	.	x	x	x	.	.
Cercocebus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
**Cercopithecoides*	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
**Parapapio*	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
**Dinopithecus*	.	.	.	x	.	.	.	.	.	.	.	x	.	.	.
Choeropithecus = *Papio*	.	.	.	.	.	.	.	.	x	x	.	x	.	.	.
**Brachygnathopithecus*[1]	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
**Australopithecus*	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Homo	.	.	.	.	x	.	.	.	.	.	.	.	x	x	.
Myosorex	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Suncus	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Insectiv. gen. indet.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
**Serengetilagus*	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Leporidae gen.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Lepus	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Xenohystrix	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Hystrix	.	.	.	.	.	x	.	.	.	x	.	x	.	.	.
Heterocephalus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
**Gypsorhychus*	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Xerus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Pedetes	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.
Muridae gen.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Tachyoryctes	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Dendromus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Saccostomus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Colomys	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Canis	.	.	x	.	.	.	x	.	x	x	.	x	x	.	.
Otocyon (incl. *Prototocyon*)	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Lycaon	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Vulpes	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Mellivora	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Aonyx	.	.	.	.	.	.	x	.	.	.	.	.	.	x	.

Genera	Wadi Natrun	Garet Ichkeul	St. Arnaud	Omo	Kanam	Olduvai I	Olduvai II	Olduval III	Olduvai IV	Serengeti	Olorgesailie	Makapansgat	Hopefield	Florisbad	Cornelia
Herpestes (incl. *Calogale*, *Mungos* in part)	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.
Cynictis	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Atilax	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.
Mungos	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Crocuta (incl. *Hyaena* in part)	.	.	.	.	x	x	.	.	.	x	.	x	x	.	.
Hyaena	.	.	x	.	.	.	.	.	x	x	.	x	x	x	.
Felis (incl. *Lynx*, *Leptailurus*, *Panthera*)	.	.	.	.	.	x	x	.	x	x	.	.	x	.	.
Acinonyx	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
**Machairodus*	x	.	.	.	.	.	.	.	.	.	.	x	.	.	.
**Homotherium*	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Felidae gen. incl.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Orycteropus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
**Anancus*	.	x	x	.	x	x	x	.	.	x	.	.	.	.	.
**Mammut* (=*Mastodon*)	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Proboscid gen.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
**Stegolophodon*	.	.	.	.	x^2	.	.	.	.	.	.	.	.	.	.
**Stegodon*	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Loxodonta (incl. *Palaeoloxodon*), } incl. *Elephas*	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
**Mammuthus* (incl. *Archidiskodon*), } incl. *Elephas*	.	x	x	x	x	x	x	x	x	x	x	.	.	.	.
**Deinotherium*	.	.	.	x	x	x	x	.	.	x	.	.	.	.	.
Procavia	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
**Hipparion* (incl. *Hypsohipparion*, *Stylohipparion*)	x	x	x	x	x	x	x	x	x	x	x	x	.	.	x
Hippotigris (=*Eurygnathohippus*, *Kolpohippus*)	.	.	x	x	x	x	x	x	x	x	x	x	x	x	x
Equus	.	x	x	.	.	x	x	x	x	.	.	.	.	.	.
**Chalicotherium*	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.
**Metaschizotherium*	.	.	.	.	.	.	.	.	.	x	.	x	.	.	.
Ceratotherium	.	.	.	x	x	x	x	x	x	x	x	x	x	.	.
**Serengeticeros* (probably = *Ceratotherium*)	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Diceros	.	.	.	.	x	x	x	x	x	.	.	x	x	.	.
Atelodus	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.
**Sivachoerus*	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Koiropotamus (=*Potamochoerus*)	.	.	.	x	x	x	.	.	x	x	x	x	.	.	.
Sus	x	x	.	x	.	x	.	.	.	x	.	.	.	.	.

Phacochoerus (incl. *Afrochoerus*)	.	.	.	x	.	.	x	.	x	x	x	.	.	x	x
**Omochoerus*	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.
Hylochoerus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
**Mesochoerus*	.	.	.	.	.	x	.	.	x	.	.	.	x	.	.
**Metridiochoerus* (incl. *Pronotochoerus*)	.	.	.	x	.	x	.	.	.	.	.	x	.	.	x
**Notochoerus* (incl. *Gerontochoerus*)	.	.	.	x	.	x	x	x	x	x	x	x	.	.	.
**Tapinochoerus*	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x
Hippopotamus	x	x	x	x	x	x	x	x	x	.	x	x	x	x	.
Okapia	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Giraffa	.	.	x	x	.	.	x	x	x	x	x	x	x	.	.
Camelus	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Strepsiceros	.	.	.	x	.	.	x	.	x	x	.	x	x	.	.
Tragelaphus	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Taurotragus	.	.	.	x	.	x	x	.	x	.	x	x	x	.	.
**Bularchus*	.	.	.	.	.	.	x	x	x	.	.	.	.	.	.
Syncerus (incl. *Bubalus* in part)	.	.	.	x	.	.	.	.	.	.	.	x	.	.	.
**Homoioceras* (incl. *Bubalus* in part)	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Bubalus (*Buballus*)	.	.	x	.	.	.	.	.	x	.	.	.	.	x	.
Cephalophus	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Philantomba	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Kobus (incl. in part *Adenota*)	.	.	.	x	.	.	.	.	.	.	.	.	.	x	.
Adenota (incl. in part *Kobus*)	.	.	.	.	.	x	x	.	x	.	.	.	.	.	.
Redunca	.	x	.	x	.	.	.	.	x	.	.	x	x	.	.
Pelea	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Hippotragus	.	.	.	.	.	.	x	.	x	.	.	.	x	.	.
Oryx	.	x	x	.	.	x	x	.	x	.	.	x	.	.	.
Damaliscus	.	.	.	.	.	.	.	.	x	.	.	x	x	.	.
**Parmularius*	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.
Gorgon	.	.	.	.	.	x	x	x	x	.	.	x	.	.	.
Alcephalus (=*Bubalis*)	.	x	x	x	.	.	x	.	x	.	.	x	.	x	.
**Peloroceras*	.	.	.	.	.	.	.	.	.	.	.	x	.	x	x
**Makapania*	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Beatragus	.	.	.	.	.	x	x	x	.	.	.	.	.	.	.
Connochaetes	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.
**Lunatoceras*	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Oreotragus	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Nesotragus	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Raphicerus	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Aepyceros	.	.	.	x	.	.	.	.	.	.	.	x	.	.	.
Gazella	.	.	.	x	.	x	x	.	x	.	.	x	.	.	x

Genera	Wadi Natrun	Garet Ichkeul	St. Arnaud	Omo	Kanam	Olduvai I	Olduvai II	Olduval III	Olduvai IV	Serengeti	Olorgesailie	Makapansgat	Hopefield	Florisbad	Cornelia
**Phenacotragus* (=*Adenota* in part)	.	.	.	.	.	.	.	.	*x*	.	.	*	.	.	.
Antilope gen.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Antidorcas	.	.	.	x	.	.	.	.	.	.	.	.	x	.	.
**Menelickia*	.	.	.	*x*	.	.	.	.	.	.	.	.	.	.	.
**Pultiphagonides*	.	.	.	.	.	*x*	*x*	.	.	.	.	.	.	.	.
Pelorovis	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
**Phaleroceros*	.	.	.	.	.	.	.	.	*x*	.	.	.	.	.	.
Bos	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 60. Generic distribution of fossils identical at African Sivatherine sites (up to 1957).

* and x = extinct genus. [1] Now included in *Simopithecus* (Freedman, 1958). [2] Probably *Archidiskodon* (Singer & Hooijer, 1958).

discovered is summarized in table 60. No material from the Vaal River deposits is included in this table because the Sivatherine specimens MMK 3685 and F 39 were recovered from unknown localities, and it would be impossible to associate them with any particular faunal group from the Vaal River as the fauna are derived from series of gravels of varying geological periods, the sequences of which have not been finalized. The data concerning the O.F.S. sites is incomplete, because in the case of Tierfontein very little is known of the associated fauna, while the mass of material collected from Florisbad and Cornelia has not been identified.

It will be noted that only the genera are given in the table, because in very many cases there is dubiety about the specific identification. Furthermore, in some cases there is controversy concerning the genera themselves and some have been referred to or included in others (Hopwood and Hollyfield, 1954). Arambourg (1947) and Leakey (1958) differ, for example, as to the generic determination of the East African suidae. Purely on a statistical basis, the genera common to two or more sites have been selected and expressed in a table of correlation (table 61).

	St. Arnaud	Wadi Natrun	Olduvai I	Olduvai II	Olduvai III	Olduvai IV	Olorgesailie	Omo	Serengeti	Kanam	Makapansgat	Hopefield	Florisbad	Cornelia
Garet Ichkeul	9	4	6	7	4	7	3	6	4	4	5	3	2	1
St. Arnaud		3	7	10	6	11	5	7	7	5	7	5	5	2
Wadi Natrun			3	2	2	2	2	3	2	2	3	1	1	1
Olduvai I				20	11	17	9	12	12	10	14	9	2	4
Olduvai II					13	22	10	13	12	8	14	10	4	4
Olduvai III						12	8	7	6	6	8	5	2	2
Olduvai IV							11	14	13	7	20	14	5	4
Olorgesailie								10	8	6	8	5	3	3
Omo									11	7	14	8	4	3
Serengeti										8	12	8	4	3
Kanam											6	6	3	2
Makapansgat												12	4	3
Hopefield													6	2
Florisbad														3

TABLE 61. Genera common to two different African sites.

(See also Appendix.) Since this table was drawn up a number of extinct genera have been identified at Hopefield and at Olduvai, but they have not been included in this table.

The interpretation of such a table must be undertaken with great care because of the varying amount of material collected from different sites. This table does not express a relative time correlation. However, if one takes Olduvai, Omo, Makapansgat and Hopefield, where large numbers of specimens have been recovered and identified, the correlation becomes more representative, but the actual figures do not indicate which genera are in common to all sites. A similarity between two sites is indicated: Hopefield for example appears to

have more in common with Olduvai IV than with Omo. Furthermore, if one estimates the extinct forms and the extant forms at each site, and works out the index of the relationship between extinct forms and the total, and between extinct and extant forms, one obtains an interesting gradation of series; especially if one selects arbitrarily those sites where there are more than a total of 15 recognized genera (table 62). For both indices one obtains the same gradation of increasing indices, namely, Hopefield, Olduvai IV, Serengeti, St. Arnaud, Makapansgat, Olduvai II and Olduvai I. It must be emphasized that this is not an attempt at an age sequence, but merely indicates the proportions of the extinct and extant fauna. Nevertheless there is some evidence that Hopefield overlaps the Olduvai IV period, and some of the faunal evolutionary sequences (e.g. higher crown of *Mesochoerus lategani* (Singer & Keen, 1955) compared with *Mesochoerus olduvaiensis*) and the more evolved human-manufactured stone tools (Singer & Crawford, 1958a), tend to corroborate this and even suggest that a portion of the 'Hopefield period' extends to slightly more recent times than the period indicated by Olduvai IV.

	Number of recognized genera			
	Total	*Extinct*	$\frac{\textit{Extinct}}{\textit{Total}} \times 100$	$\frac{\textit{Extinct}}{\textit{Extant}} \times 100$
Garet Ichkeul	13	3	23·1	30·0
St. Arnaud	16	4	25·0	33·3
Wadi Natrun	9	4	44·5	80·0
Olduvai I	28	10	35·7	55·6
Olduvai II	28	9	32·0	47·5
Olduvai III	13	5	38·4	62·3
Olduvai IV	35	7	20·0	25·0
Olorgesailie	11	4	36·4	57·0
Omo	26	9	34·6	53·0
Serengeti	33	8	24·3	32·1
Kanam	14	6	42·9	75·0
Makapansgat	48	15	31·2	45·5
Hopefield	30	5	16·7	20·0
Florisbad	14	1	7·1	7·7
Cornelia	7	4	57·2	132·6

TABLE 62

However because *all* the material from Olduvai, Makapansgat and Hopefield has not yet been definitely identified, these indices may have to be altered in time (see 'Appendix'). The data indicate clearly how, throughout Africa, a large percentage of the fossil material is extant and how these extant forms are widespread throughout the African Pleistocene. Consequently, it is not surprising that *Giraffa* has been recovered from Upper, Middle and Lower Pleistocene sites, and that *Sivatherium* has been recognized in each of the four Beds at Olduvai and even at Omo.

Confined to Stage I — Omo-Kanam	Common to I–II	Confined to Stage II — Olduvai I–II Serengeti	Common to II–III	Confined to Stage III — Olduvai III–IV Olorgesailie
Dinopithecus	*Crocuta*	*Hystrix*	*Simopithecus*	*Otocyon*
Lepus	*Anancus*	*Aonyx*	*Canis*	*Bubalus*
Syncerus	*Deinotherium*	*Acinonyx*	*Mesochoerus*	*Nesotragus*
Aepyceros	*Sus*	*Chalicotherium*	*Bularchus*	*Philantomba*
Kobus	*Metridiochoerus*	*Pultiphagonides*	*Adenota*	*Phenacotragus*
Antidorcas	*Mammuthus*	*Parmularius*	*Hippotragus*	*Redunca*
Menelickia		*Serengeticeros*	*Gorgon*	*Pelorovis*
Omochoerus		*Serengetilagus*	*Beatragus*	*Damaliscus*
Stegodon		*Heterocephalus*	*Felis*	*Thaleroceras*
Archidiskodon		*Xerus*	*Notochoerus*	
Homotherium		*Pedetes*	*Choeropithecus*	
		Tachyoryctes	*Equus*	
		Mungos		
		Orycteropus		
		Metaschizotherium		
		Hylochoerus		
		Okapia		
16·2%	8·8%	25·0%	17·6%	13·2%

Common to Stages I, II and III

Hyaena	*Phacochoerus*
Hipparion	*Hippopotamus*
Ceratotherium	*Giraffa*
Diceros	*Alcelaphus*
Potamochoerus	*Oryx*
Gazella	*Strepsiceros*
	Taurotragus

19·2%

Total: 68 genera.

TABLE 63. Correlation of East African Pleistocene Fauna.

A correlation of the East African fauna as it is presently described, according to the stages recognized (table 63), produces a number of genera (20%) common to all three stages, which is almost identical to incidences in the Hopefield material. This indicates that throughout Africa about 20 per cent of approximately 70 genera persisted (though possibly undergoing specific determination) over a great length of time, despite changing ecological and climatological conditions. Furthermore, in respect of a single genus, namely, *Giraffa*, and one single species, *camelopardalis*, which has been recovered from the Lower Pleistocene (at Omo, see Arambourg 1947), there has been no evolutionary change, despite its wide dispersal—chronological, climatological and spatial. This fact demonstrates the tremendous adaptability of *G. camelopardalis*. However, during this period, a much smaller species, *G. gracilis*, became extinct, as well as two genera (*Sivatherium* and *Libytherium*) of another subfamily (Sivatheriinae).

APPENDIX

After the MS. had been completed, three series of giraffid material were made available to the authors. Newly discovered specimens from the Limeworks breccia at Makapansgat were kindly sent by Mr. J. W. Kitching from the Bernard Price Institute for Palaeontological Research, Johannesburg. The Curator of Vertebrate Palaeontology (Dr. A. J. Sutcliffe) of the British Museum (Natural History) informed us that some more East African fossil giraffid specimens had been found in storage which had previously not been known to be available. The third series, one specimen, was discovered by one of the authors (R. S.) at Baard's Quarry, Langebaan (Cape Province), which is about 10 miles NW. of the Elandsfontein site at Hopefield. This specimen, an astragalus, had been recovered, with other bones, from the layer of phosphatic nodules about 5–10 feet below the surface. Most of the bones have been identified and they belong to animals similar to those found at Elandsfontein. Only one identifiable specimen, *Stegolophodon* sp., belongs to a much earlier horizon (Singer & Hooijer, 1958).

A. Makapansgat

Material

I. Giraffa

M 2085: Left M_2 or M_1.
M 1801: Right canine with tip of root broken off.
M 1798: Portion of left ramus of mandible with M_1 and fragmented M_2.
M 1800: Fragment of maxilla with portions of right M^1, P^4.

II. Sivatheriinae

M 2087: Fragment of mandible containing unerupted I_1, I_2.
M 2086: Fragmented right M_3.
M 539 A: Now in British Museum (Natural History) and numbered M 16729. Jaw fragment of juvenile.

Description

I. Giraffa

M 2085

This is a left lower molar, probably M_2, but the possibility of its being M_1 cannot be ruled out. It is a complete tooth with a fragment of mandible between its roots. The crown is identical in appearance to M 942—M 1113, except that

(i) M 942 has a minute ectostylid and M 2085 has no trace of it;

(ii) the stylids on the lingual surface of M 2085 are less marked than those of M 942—M 1113;

(iii) M 2085 is in a more advanced stage of wear; and

(iv) the posterior pillar of M 2085 is more rounded at the base of the buccal surface than M 942—M 1113, and M 2085 does not present the same marked indentation of the crown on the posterior surface that M 942—M 1113 has.

The roots of M 2085 are very robust, being more massive than those of the modern *G. camelopardalis*, although they are as short.

	Crown	Length	Breadth	Height *Lingual*	Height *Buccal*
(*a*)	Anterior pillar	15·5	25·5	19·6	16·3
	Posterior pillar	17·7	25·0	18·5	14·3
	Whole tooth	34·7	25·5		
(*b*)	Roots	Breadth	Height		
	Anterior ..	24·4	28·8		
	Posterior ..	23·7	28·0		

Table 64. Measurements of M 2085 (mm.).

These dimensions fall within the range of the other Makapansgat fossil *Giraffa*; the breadth falls within the range of variation (at upper end) of the modern *Giraffa camelopardalis* while the length falls just outside the range of the modern species.

This, like the other Makapansgat *Giraffa* specimens, is included in *G. camelopardalis*.

M 1801 (Pl. 23, e, f)

This is a rather worn right canine with most of the root intact. It presents no features not present in a canine of a modern *G. camelopardalis*. Its dimensions fall within the range of the modern species:

Crown:	Length:	21·5 (mm.)
	Breadth:	10·2
	Height:	18·0
Root:	Base-tip:	33+

M 1798

A portion of the left horizontal ramus of a mandible with a complete M_1 and a portion of the anterior pillar and the entoconid of M_2. The buccal portion of the mandible is partly broken away exposing the anterior root of M_1 and the sockets of the roots of P_4. The teeth are in a fairly advanced stage of wear, intermediate between the stages of M 942—M 1113 and M 2085. The general appearance of M 1798 is similar to that of the other Makapansgat fossil *Giraffa* M_2 specimens, except that it has a prominent ectostylid and only a slight hypostylid which has been worn away by the abutting anterior pillar of M_2. The anterior root of M_1 tapers towards the tip, in contrast to that of M 2085 which is rectangular.

This specimen is the only M_1 of the fossil *G. camelopardalis* in the present survey.

The remaining portion of the M_2 of M 1798 resembles the other M_2 Makapansgat specimens, being tightly wedged against the posterior pillar of M_1. On the lingual surface of the entostylid the median costa is dimpled by a V-shaped vertical depression.

(*a*) Mandible: Breadth opposite M_1/M_2: *c.* 34
Height opposite P_4/M_1: *c.* 54

	M_1	Length	Breadth	Height *Lingual*	Height *Buccal*
(*b*)	Anterior pillar	15·5	23·7	*c.* 14	14·9
	Posterior pillar	16·3	23·4	*c.* 15	14·2
	Whole tooth	31·6	23·7		
	M_2				
	Anterior pillar	16·3	*c.* 23	*c.* 20	18·0
	Posterior pillar	—	—	20·6	—

Table 65. Dimensions of M 1798 (mm.).

M 1800

A fragment of right maxilla containing portions of P^4 and M^1. They are in a very advanced stage of wear, the most worn down of the Makapansgat *Giraffa* series.

M_1	Length	Breadth	Height *Lingual*	Height *Buccal*
Anterior pillar ..	11·5	29·0	7·0	6·5
Posterior pillar ..	—	—	—	8·2
Whole tooth ..	25+	—	—	—

Dimensions of M 1800 (mm.)

II. Sivatheriinae

M 2807

A fragment of the right body of a Sivatherine mandible, the symphyseal aspect of which fits that of M 553A perfectly (Pl. 40). A small portion of the posterior border of the body is present forming an arch with that of M 553A, but an anterior directed fracture has separated the body from the horizontal ramus about 1 cm. along the posterior border to the right of the symphysis. The anterior half of the mental foramen is present, as well as a small accessory foramen 11 mm. beyond the anterior border of the mental foramen with which it is continuous by a canal in the bone. Anteriorly the unerupted crowns of I_2 and I_3 are visible where the outer bony alveolus has been broken away and

the socket for the root-tip of I_1 is visible. It is evident that I_2 is at a more advanced stage of the process of eruption than I_3 which is 'impacted' against I_2 and is partly overlapping it. The anterior enamel edge of the crown of each tooth is at an angle of about 45° to the superior surface of the body of the mandible, the medial edge of each enamel border being nearer the surface. Furthermore it is obvious that I_2 considerably overlapped the plane of I_1, indicating that during subsequent growth considerable lateral expansion of the body was still to occur so as to accommodate all the teeth (see also p.498). It is curious that there is no sign of the canine, although the broken edge of the mandible just lateral to I_3 appears to be the socket for the root. On the left this region is obscured by breccia. The order of eruption, as regards the premolar-incisor-canine teeth, then, simulates that in modern *Giraffa camelopardalis*. The enamel of the incisor is fairly rugose and the crown enamel is markedly convex, the occlusal edge of the enamel projecting vertically. If one mentally reconstructs the anterior portion of the body one obtains the conviction that the incisor would not be in the same plane as the superior surface of the body but rather at about 45° to it. This tends to confirm our opinion stated on page 498 that the incisor-canine row of the Makapansgat *Sivatherium olduvaiense* would be at an intermediate position between *Hydaspitherium* sp. (AMNH 19684) and *Giraffa camelopardalis*.

It is now possible to assess more accurately the length of the body of the mandible, namely, about 120 mm. This specimen also indicates that the height of the body of the mandible relative to the breadth of the body is greater in the immature individual. With maturation of the individual the depth decreases and the breadth increases. This principle also pertains to the modern *G. camelopardalis*.

The only measurement that can be taken on the teeth is the breadth of the crown of I_2, namely, 23·7 mm.

M 2086

This is a right M_3, broken off at the crown-root junction with the anterior pillar almost complete, the posterior pillar having the occlusal portion of the hypoconid broken off, and the talonid having most of the buccal cone broken away. The slightly rolled edge of the enamel of the occlusal surface indicates that the tip of the crown of the tooth was only just above the alveolar margin of the mandible, so that most of this specimen must still have been embedded in the mandible. This very early stage of eruption is in conformity with that at which a M_3 of M 553B^1 would have been expected to be. Furthermore, as was found with M 2087 which belongs to M 553A, it would be reasonable to conclude that M 2086 is the M_3 of the right side of the individual to which M 553B^1, M 553B, M 553 and M 2087 belong. It can also be concluded that this specimen supports the view that the order of eruption of the molars of *Sivatherium* is the same as that in *Giraffa camelopardalis*, namely, M_1–M_2–M_3 in that order.

It is interesting to note that in M 2086 the angularity of the buccal cones seen in M 553B[1] is obvious only in the second pillar of M 2086 while its anterior pillar is more rounded.

In general appearance, M 2086 closely resembles M_3 of Old. SK. II, 92, except that the parastylid of M 2086 is a more marked ridge, while the median ridge (costa) of each pillar of M 2086 is not yet as prominently developed as those of the Olduvai specimen (which is at a much later stage of eruption). The finely rugose buccal surface of M 2086 has three horizontal ridges on the enamel on the anterior pillar and one on the posterior pillar—these are more marked than in Olduvai 92.

Measurements of M 2086 (*mm.*):

	Length	Breadth	Height *Lingual*	Height *Buccal*
Anterior pillar ..	28·0	33·0	49+	49+
Posterior pillar ..	22·0	29+	51+	—
Talonid	14+	19+	31+	—
Whole tooth ..	66+	33·0	—	—

It is clear that this specimen falls within the range of the measurements of *Sivatherium olduvaiense*, and, being the least worn of the M_3 series, it extends the upper range of variation of the height of the tooth to 51+ mm.

M 539A (Pl. 36, g)

This is the number given by the Bernard Price Institute for Palaeontological Research, Johannesburg, but it is now permanently in the British Museum (Natural History) where it has been given the number **M 16729.**

It is a fragment of a left mandibular ramus of a juvenile and definitely belongs to the opposite side of the Sivatherine specimen M 539B. It contains the two posterior pillars of DM4, the most anterior pillar being broken away.

Measurements of mandibular fragment (*mm.*):

Length ..	73·4
Thickness ..	31·3

B. Additional East African Specimens

The additional giraffid specimens in the British Museum (Natural History) are mainly fragmentary and are derived from Olduvai Gorge (Tanganyika), Laetolil beds (Vogel River, Tanganyika) and Broken Hill (Northern Rhodesia) (figs. 17a, 17b). Brief descriptions of the Sivatherine specimens only are given.

(*a*) Olduvai Gorge

MATERIAL

I. Giraffa

M 14778: Axis. Bed I.
M 14781: Cervical vertebra (7th). Bed I.
M 14792: Calcaneum. Bed I surface.
M 14793: Metacarpal, distal end. Bed I.
M 14794: Metatarsal, distal end. Bed I.
M 14795: Metacarpal, distal end. Bed II.
M 14796: Metatarsal, distal end. Bed II.
M 14797: Metatarsal, distal end. Bed II, surface.
M 14798: Metacarpal, proximal end. Bed I.

II. Sivatheriinae

M 14535: Horn core fragment. Bed I.
M 14779: Cervical vertebra (6th). Bed IV.
M 14780: Cervical vertebra (6th). Bed I, surface.
M 14791: Tibia. Bed III.
M 17024–6: Three molar teeth.
?: Unnumbered left lower molar. G. RK III.

III. Giraffid (no generic distinction possible)

No numbers on specimens. Letters refer to sites.

Astragalus	Oldy.	FLK	II	S	
	—	DC	II		
	—	HEK	II	S	
	—	HEK	II	S	
	—	GTS	IV	S	
	—	GRK	II	S	
Phalanx I	Oldy.	GHJK	II	S	
	—	EHK	I		
	—	DK	I	S	
	—	HEK	II		
Calcaneum ..	GRK	II	S		
Tibia	Oldy.	FC	II	S	(distal end)
	—	EK	I	S	(proximal end)
	—	SC	II	S	(proximal end)
	—	GRK	II	S	(proximal end)
	—	DK	I	base	
Cubonaviculare					
(Scaphocuboid)	Oldy.	THC	I	(Y)	
	—	VEK	I		
	—	SHK	II	S	

Metapodial ..	Oldy.	FC	II	S	(distal end)
	—	DK	I	S	(distal end)
	—	HEK	I		(distal end)

(*b*) Laetolil Beds

I. Sivatheriinae

M 15088: Lower molar (or premolar).
M 15089: Upper premolar.
M 15090a, b: Lower premolars.

II. Giraffid

Cubonaviculare (Scaphocuboid)	1710.5
	Lit.A.S.
Phalanx I	MnX.S.
	LIT.AS.
Astragalus	1710 S
	LIT.A.

(*c*) Broken Hill

I. Giraffa

M 12128 .. Tibia, distal end.
? .. .. Unnumbered horn-core, cervical vertebra and distal end of a femur.

II. Sivatheriinae

M 12128 .. Metacarpal, distal end. (Same number as *Giraffa* tibia.)
M 12129 .. Astragalus.

III. Giraffid

Radius, distal end.

Description of Sivatherine Specimens

M 14535

This fragment of horn core is entered in the record book as being derived from 'Middle Pleistocene Bed I Olduvai, Tanganyika, Leakey collection 1932'.

One side is slightly convex in an A–P direction and has 3 deep, wide grooves (7–8 mm. in breadth) more or less parallel to each other and to the length axis of the horn. The other surface is concave and relatively smooth.

Although it is a small fragment it is very similar to the South African specimens. It is typically Sivatherine.

M 14791

This is a complete tibia. Its dimensions are compared with the average of 5 *Giraffa camelopardalis* from Central Africa in the Musée Royal du Congo Belge in Tervuren.

		M 14791	*Giraffa camelopardalis*
Total length		473	639
Proximal end:	Transverse	153·5	151·8
	A–P ..	138·0	92·4
Mid-shaft:	Transverse	64·3	70·6
	A–P ..	49·4	55·8
Distal end:	Transverse	101·0	109·0
	A–P ..	75·4	76·2

Table 66. Measurements (mm.) of M 14791 compared with *Giraffa camelopardalis.*

This again bears out the contention expressed above that *Sivatherium olduvaiense* is much shorter and has more massive extremities than the modern giraffe.

M 17024–26

These 3 teeth of *Sivatherium olduvaiense* are all derived from Bed II.

M 17024

This is a right lower molar, either M_1 or M_2. The posterior end of the posterior pillar has been broken away. It is in early wear and the enamel is very rugose. It is markedly hypsodont and the cingulum bulges slightly. The costae are very prominent, as are also the protostylid and metastylid. The roots are broken off.

Measurements (mm.) of M 17024:

Maximum breadth	34·6
Occlusal breadth, anterior pillar ..	17·8
posterior pillar ..	17·9
Height, lingual	42
buccal	50·4

M 17025

This right upper molar is probably M^2. The anterior pillar is partly broken away on the buccal side. The enamel is coarsely rugose. The lingual surface slopes markedly from the base in a buccal direction. The styles are very prominent. The roots are broken off.

Measurements (mm.) of M 17025:

Maximum length ..	49
Maximum breadth ..	43
Occlusal length ..	26·9

M 17026

This is a left M^1 or M^2 in advanced wear. There is no cingulum. There is a marked protostyle and the median costa of the anterior pillar is flattened. Most of the posterior pillar is missing and the 2 buccal roots are broken off. The lingual root forms a broad plate.

M 15088–15090

These Sivatherine teeth are from the Laetolil Beds (Vogel River) and recorded as 'Pleistocene Tanganyika. Leakey collection 1935'. M 15088 and 15090a, b are lower P_4 and M 15089 is an upper premolar.

M 15089

This right upper premolar has its crown fairly well preserved. It is finely rugose and the lingual surface has a marked slope. The median costa is very prominent. The root is broken off.

M 15090a

Its anterior root is broken away and belongs to the side opposite that of 15090b.

M 15090b

The anterior pillar is worn down and it projects much more than the posterior pillar. The enamel is very finely rugose. The buccal surface of the anterior pillar is missing and the roots are broken off.

	Length (A–P)		Breadth		Height	
	Max.	*Occlusal*	*Max.*	*Occlusal*	*Buccal*	*Lingual*
M 15088	38·7	36·2	33·0	20·0	30·6	32·5
M 15089	33·2	29·8	46·7	33·3	29·8	26·0
M 15090*a*	37·8	35·5	27·8	—	13·1	21·4
M 15090*b*	36·3	36·2	32·0	28·7	24·6	30·1

Table 67. Measurements (mm.).

Unnumbered GRK II Olduvai

This is a lower left molar, probably M_2. It is still embedded in matrix. The stylids are very prominent.

Measurements (mm.):

Maximum length ..	47
Maximum breadth ..	49
Occlusal breadth ..	33
Height	32

M 14778

This is an axis. The total height is 172 mm. and the total A–P length is 160 mm. The neural canal measures 40 mm. transversely and 38 mm. A–P. The inferior articular surface measures 65 mm. transversely and 77 mm. A–P.

M 14779

This is a 6th cervical vertebra. The maximum breadth of the body is 132 mm., and the inferior articular surface measures 74×57 mm.

M 14781

This is a 7th cervical vertebra from Bed I at Olduvai. The maximum breadth of the body is 115 mm., the neural canal is 45 mm. in diameter and the inferior articular surface is 104 mm. broad and 76 mm. A–P. The condyle (on superior aspect of the body) measures 67×51 mm.

M 12128 and **M 12129**

These are specimens from Broken Hill, Northern Rhodesia. It is not certain whether these are Sivatherine.

M 12128. This is a distal end of a metacarpal and measures 117×74 mm.

M 12129. This is an astragalus and measures 81×122 mm.

The following giraffid postcranial specimens are from the Olduvai Gorge. They are not numbered and no generic distinction is possible. Only relevant measurements (mm.) are given.

(i) *Astragalus*

	Max. length	A–P	Transverse
No site	106	60	70
Oldy FLK II S ..	103	61	65
„ DC II ..	101	54	63
„ HEK II S ..	111	67	73
„ HEK II S ..	102	63	65
„ GTC IV S ..	101	62	63
„ GRK II S ..	106	62	70

(ii) *Phalanx I*

	Maximum length	Shaft *A–P*	Shaft *Transv.*	Prox. end *A–P*	Prox. end *Transv.*	Distal end *A–P*	Distal end *Transv.*
Oldy GHJK II S ..	104	44	54	57	58	37	55
„ EHK I ..	121	—	—	56	59	37	53
„ DK I S ..	114	46	52	58	59	34	55
„ HEK II ..	109	44	46	54	54	37	50

(iii) *Calcaneum*

GRK II S	Maximum length	..	222
	Body: transv.	..	54
	height	..	69

(iv) *Tibia*

Distal end fragment: Oldy FC II S Transv. .. 97
A–P .. 69

Proximal end fragment (without fibular style):

	Transverse	A–P
EK I S ..	110	74
SC II S ..	105	69
GRK II S ..	87	77
DK I Base ..	87	81

(v) *Cubonaviculare* (scaphocuboid)

	Thickness	A–P	Transverse
Oldy THC I (Y) ..	42	76	103
„ VEK I ..	43	77	101
„ SHK II S ..	36	64	84

(vi) *Metapodial*

Distal end fragments:	A–P	Transverse
FC II S	50	93
DK I S	65	112
HEK I	57	105

The following giraffid postcranial specimens are from the Laetolil Beds (Vogel River, Tanganyika):

(i) *Astragalus*

	Max. length	A–P	Transverse
1710 S ..	113	58	62
LIT. A ..	102	58	62

(ii) *Phalanx I*

	Maximum	Shaft		Prox. end		Distal end	
	length	*A–P*	*Transv.*	*A–P*	*Transv.*	*A–P*	*Transv.*
MnX S ..	97	39	35	48	49	43	30
LIT. AS ..	104	57*	45	47	49	39	27

(* denotes exostosis included)

(iii) *Cubonaviculare* (scaphocuboid)

	Thickness	A–P	Transverse
1710.5 ..	47	89	107
LIT. A.S. ..	40	82	105

C. Langebaan (Cape Province)

S.A.M. 11715 (Pl. 50, c, d)

This is an almost complete right astragalus (talus) now housed in the South African Museum, Cape Town. It is longer than Olduvai 102 and 107,

but its general appearance is identical to theirs. It belongs to *Sivatherium olduvaiense*.

Maximum proximo-distal length	123+
Maximum A–P length medially	71
Maximum A–P length laterally	*c.* 67
Maximum breadth proximally	84+
Maximum breadth distally	74
Maximum articular breadth proximally	71
Maximum articular breadth distally	74

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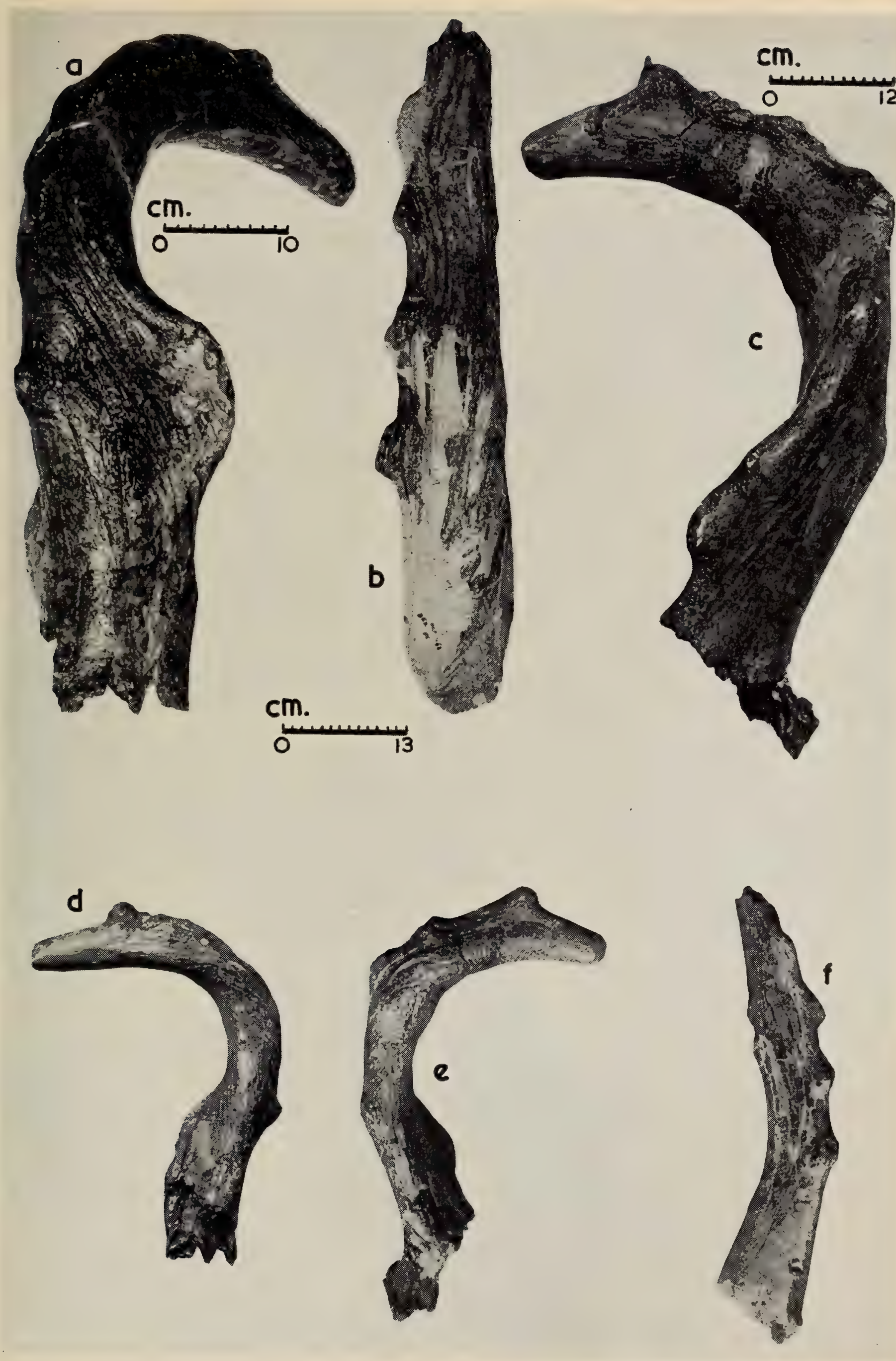
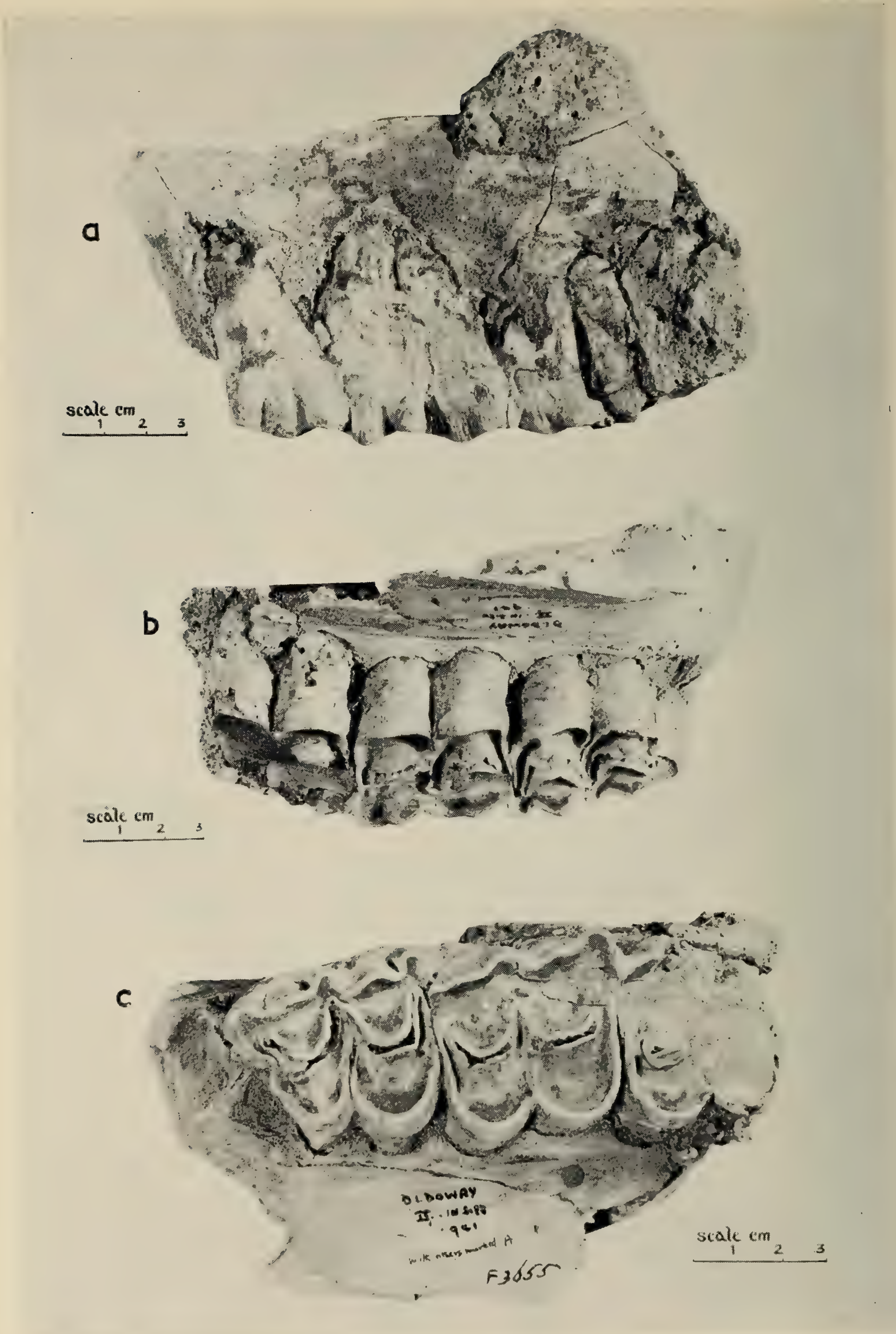


a—Old. 2.53, antero-medial aspect. *b*—Old. 86, antero-medial aspect. *c*—Old. 1.53, antero-medial aspect. *d*, *e*, *f*—Old. 2.53, 1.53, 86 respectively, illustrating the described features on their postero-lateral aspects. No scale.

Old. 3.53: *a*, *c*—postero-lateral and anterior views, respectively, illustrating features described. No scale. *b*—antero-medial aspect.

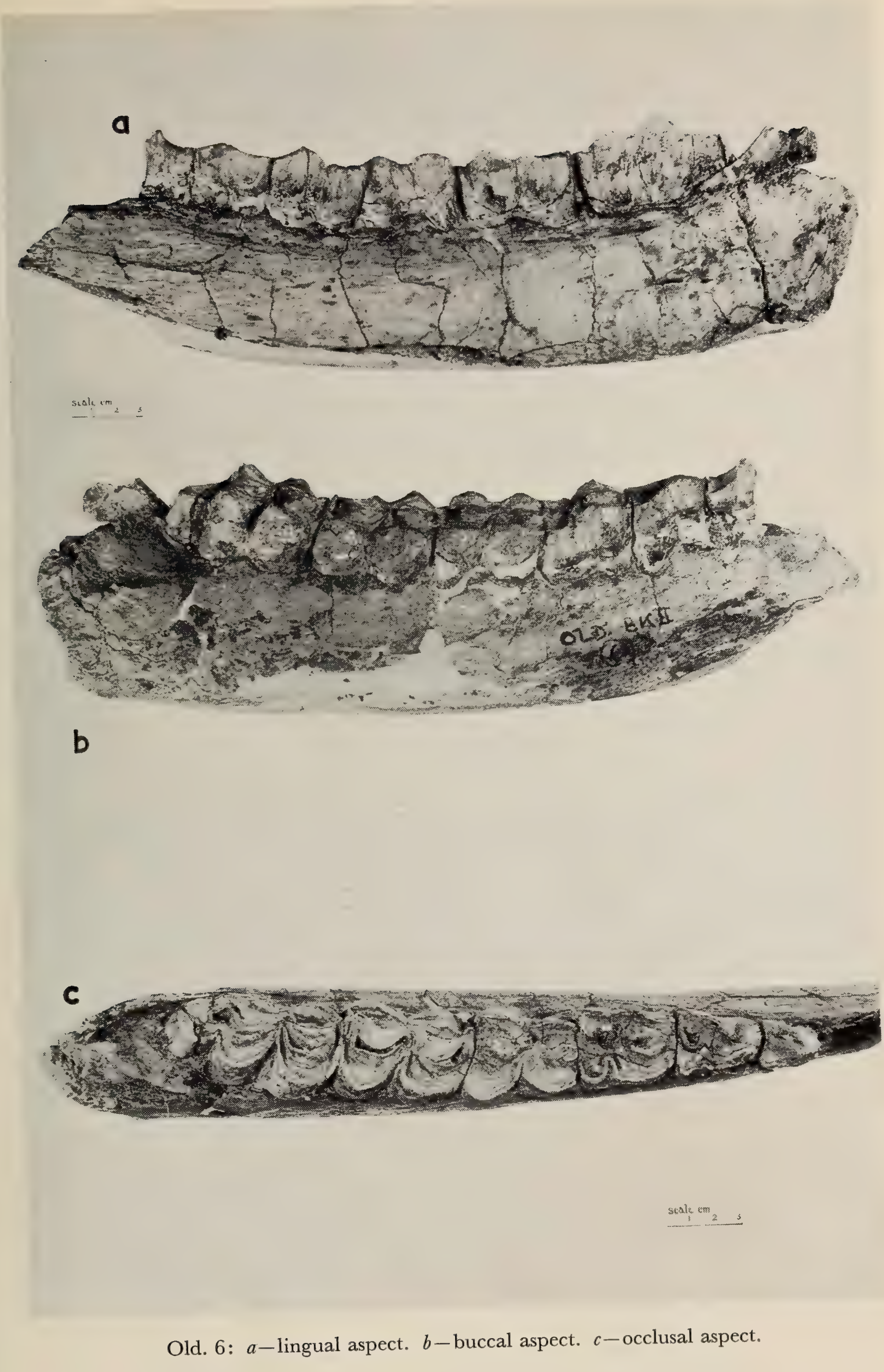
a, b—postero-lateral and antero-medial aspects of M 14955 (Olduvai), respectively. *c*—Old. 1952 SHK II BK II base (S) *plus* M 14954*b*, antero-medial aspect. *d*—*idem*, postero-lateral aspect. No scale.



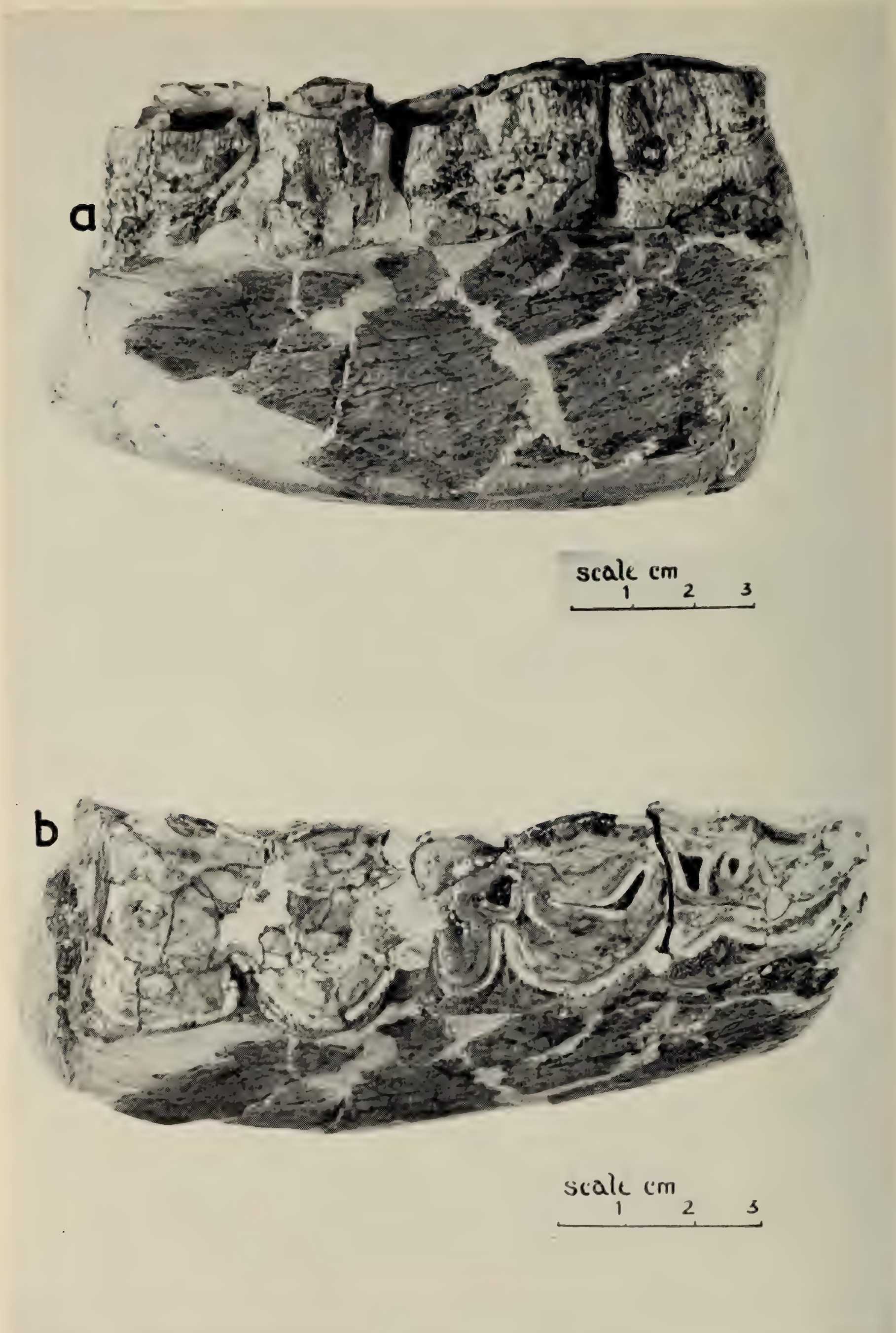
F 3655 (Olduvai): *a*—buccal aspect. *b*—lingual aspect. *c*—occlusal aspect.

a—Old. 93, buccal aspect. *b*—Old. F 3656, buccal aspect. *c*—Old. 93, lingual aspect. *d*—Old. F 3656, lingual aspect.

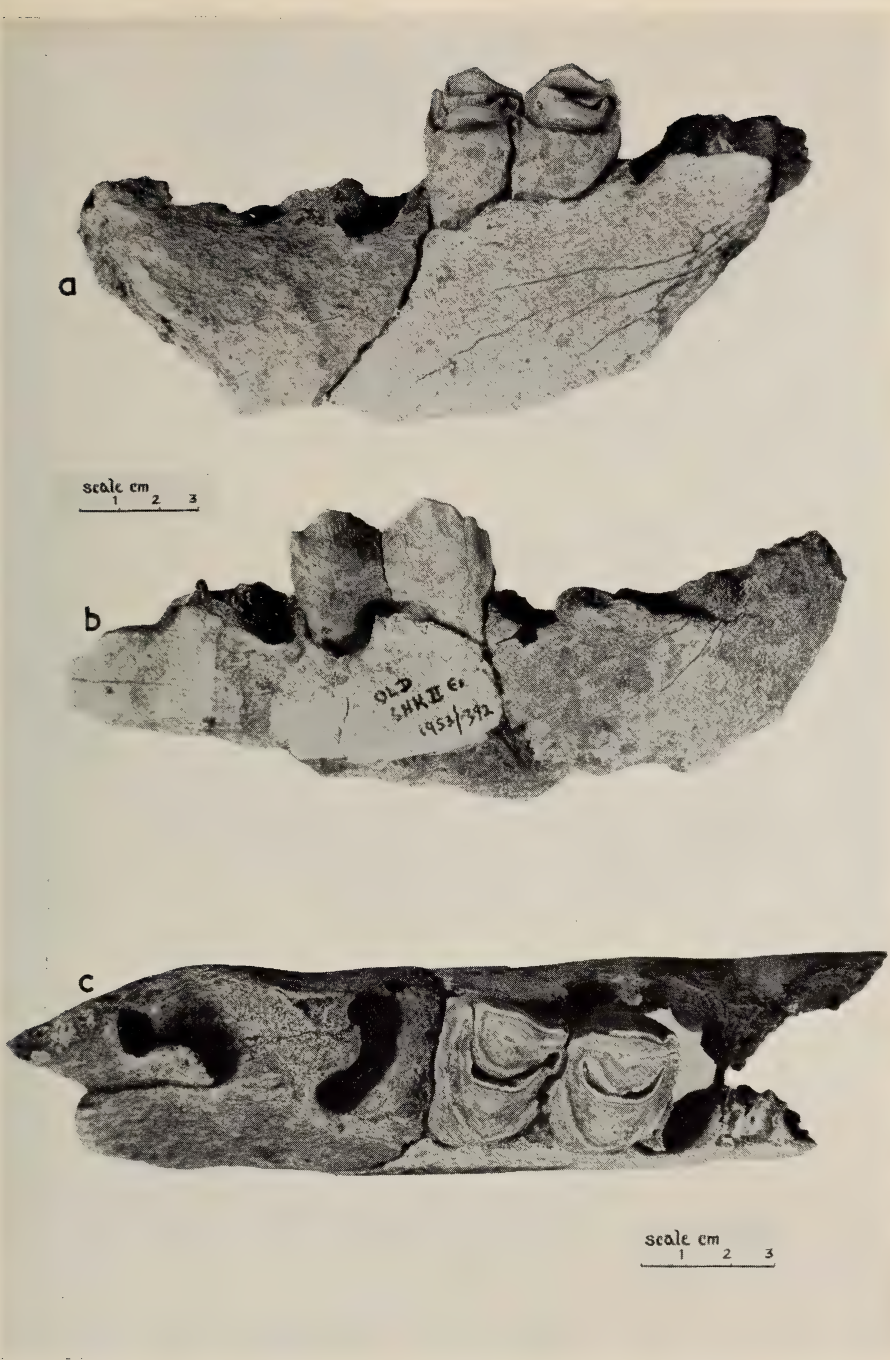
a—Old. F 3656, occlusal aspect. *b*—Old. 93, occlusal aspect. *c*—Old. 1, buccal aspect. *d*—Old. 1, lingual aspect. *e*—Old. 1, occlusal aspect.



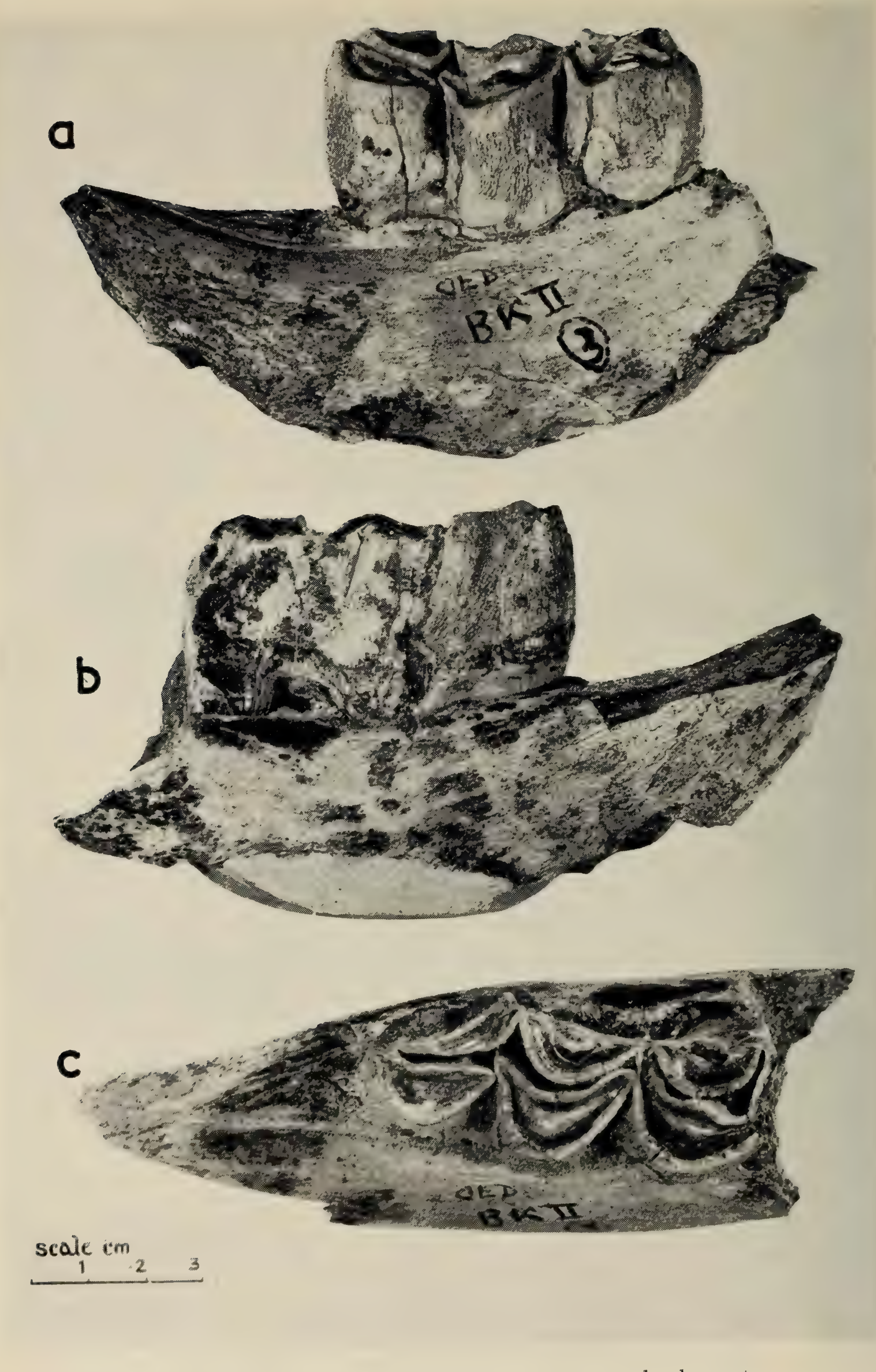
Old. 6: *a*—lingual aspect. *b*—buccal aspect. *c*—occlusal aspect.



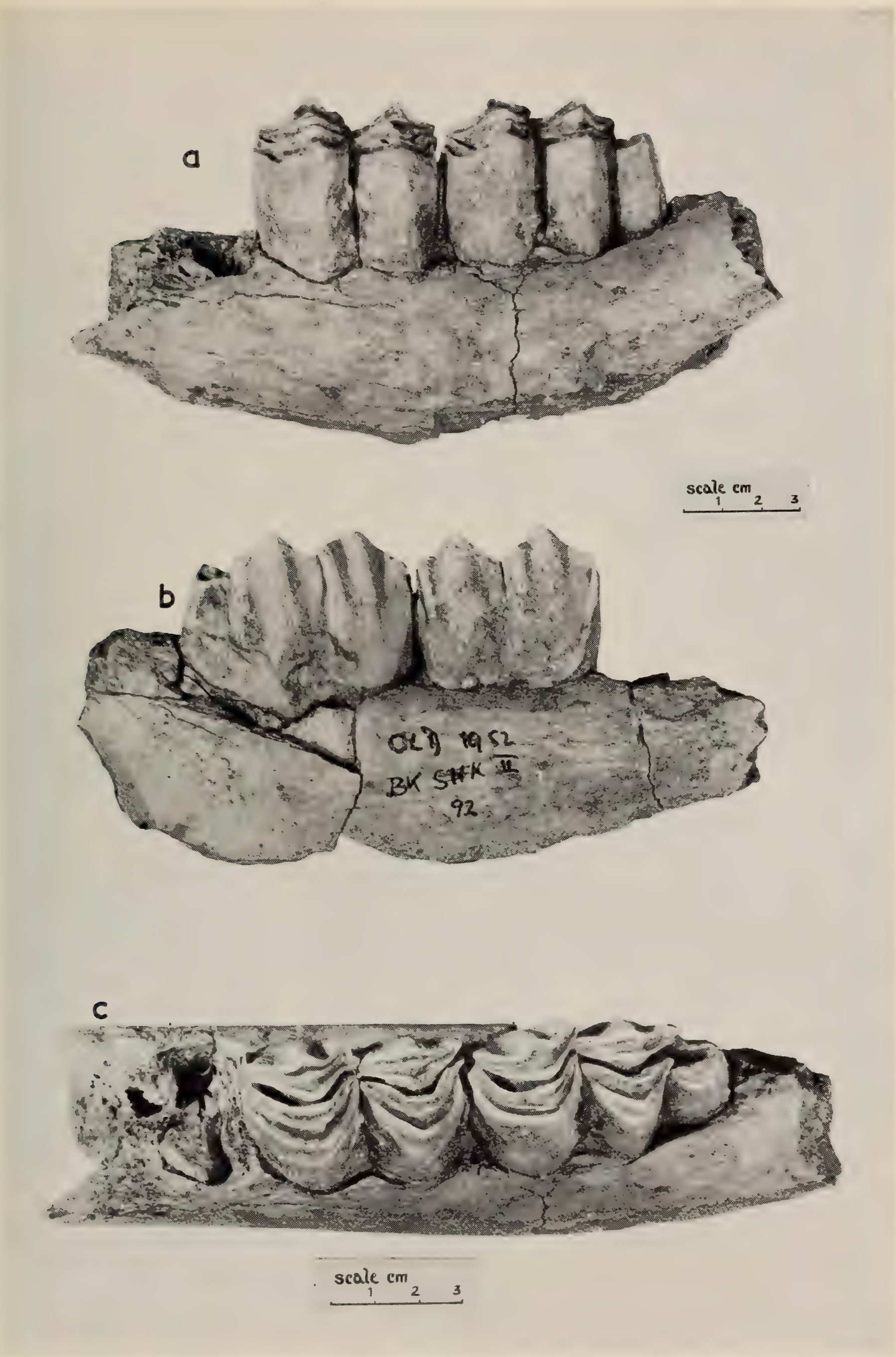
Old. 365: *a*—buccal aspect. *b*—occlusal aspect.



Old. 392. *a*—buccal aspect. *b*—lingual aspect. *c*—occlusal aspect.

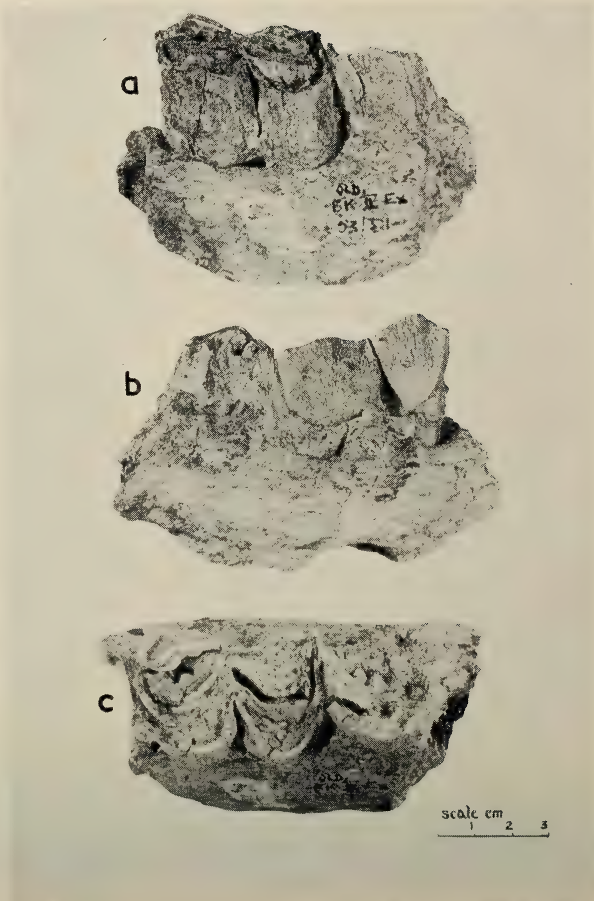


Old. 3. *a*—buccal aspect. *b*—lingual aspect. *c*—occlusal aspect.



Old. 92: *a*—buccal aspect. *b*—lingual aspect. *c*—occlusal aspect.

Nguntiri site. *a*—buccal aspect. *b*—lingual aspect. *c*—occlusal aspect.

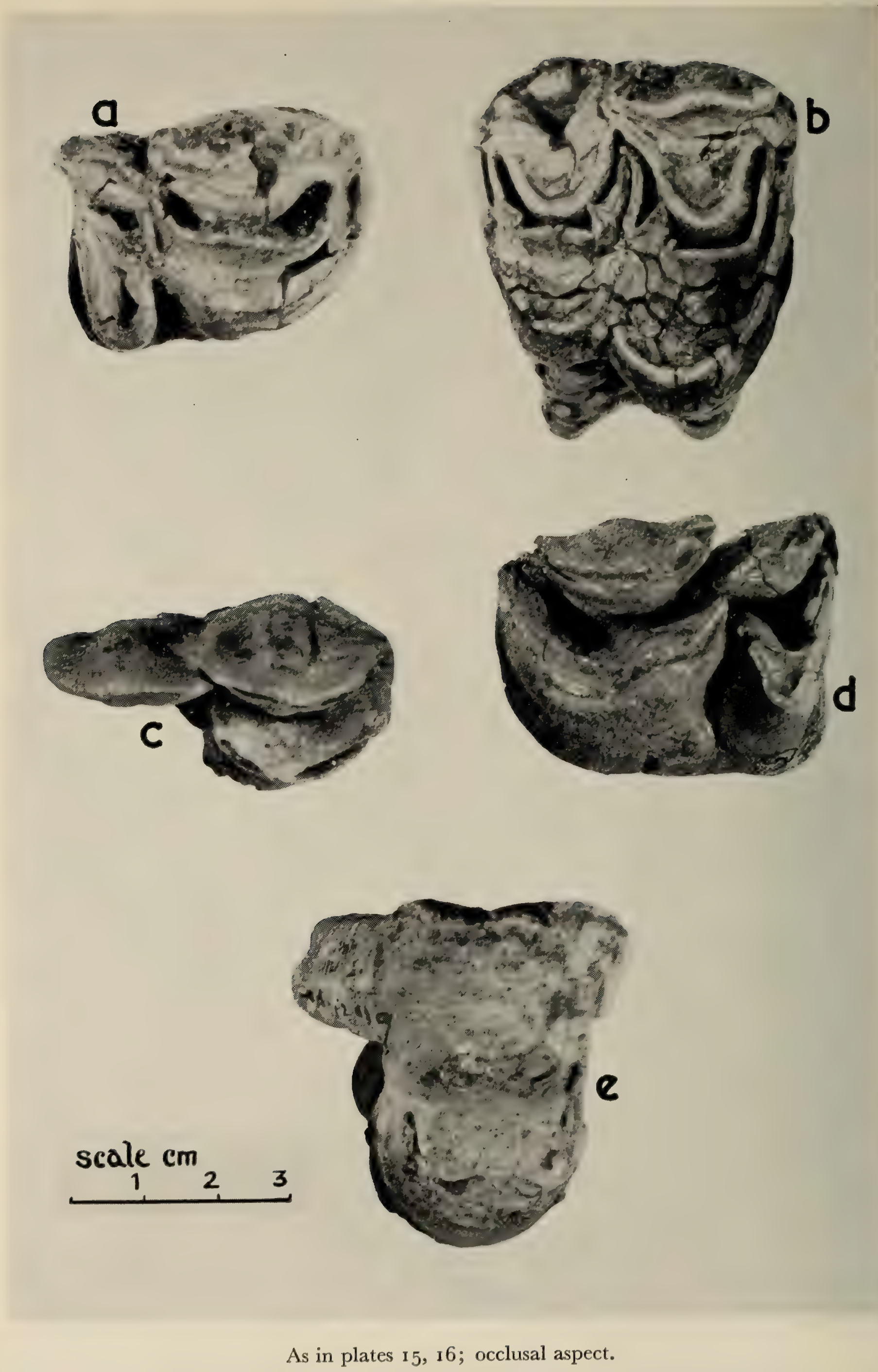


Old. 321: *a*—buccal aspect. *b*—lingual aspect. *c*—occlusal aspect.

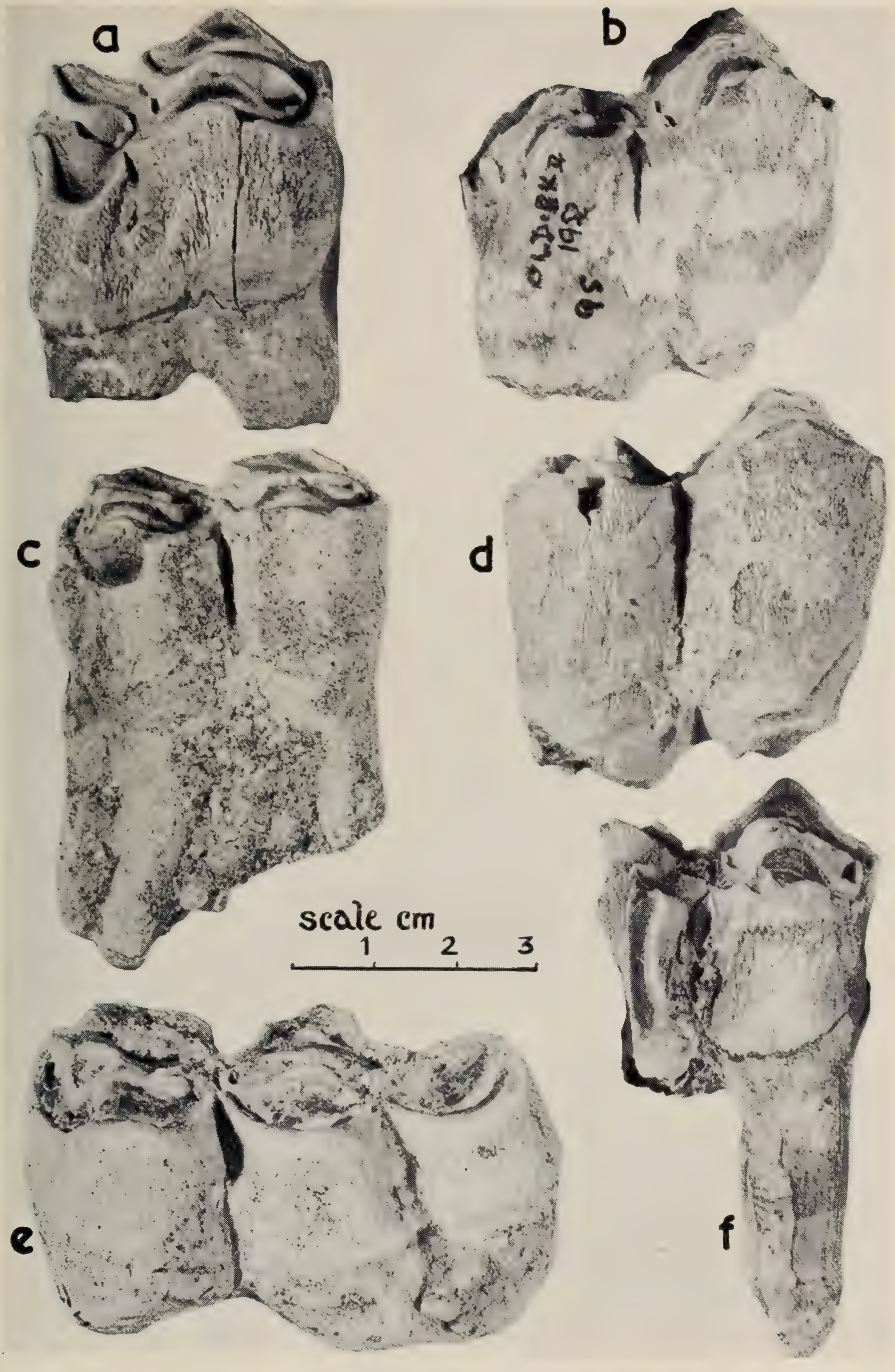
a—Old. F 2993, buccal aspect. *b*—Old. F 2993, lingual aspect. *c*—Old. F 2993, occlusal aspect. *d*—Old. 109, buccal aspect. *e*—Old. 109, lingual aspect. *f*—Old. 109, occlusal aspect. *g*—Marsabit Road, buccal aspect. *h*—Marsabit Road, lingual aspect. *i*—Marsabit Road, occlusal aspect.

a—Old. 2, buccal aspect. *b*—Old. 4, buccal aspect. *c*—Old. 116, buccal aspect. *d*—Old. 5, buccal aspect. *e*—Old. F 2989, buccal aspect.

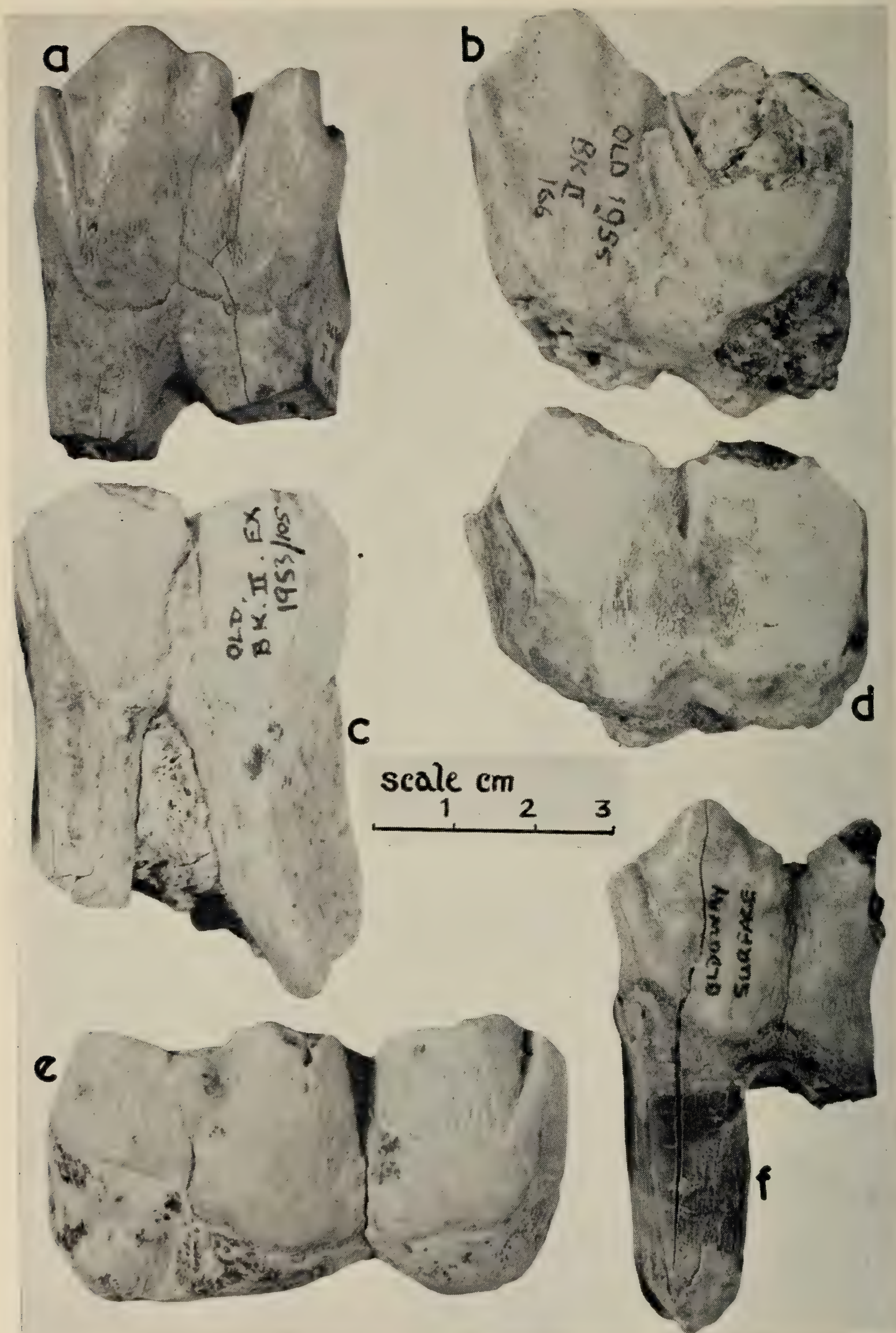
As in plate 15; lingual aspect.



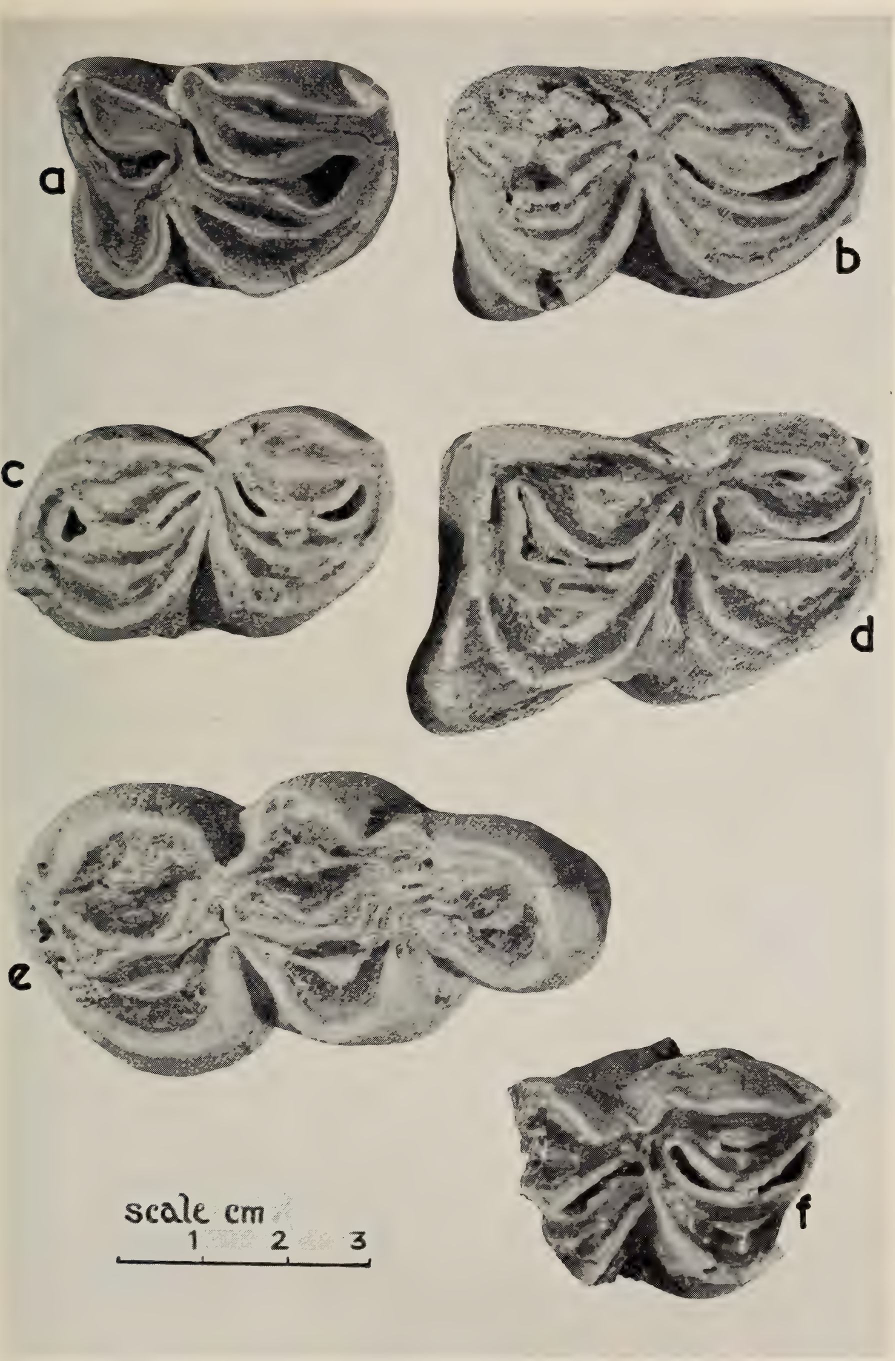
As in plates 15, 16; occlusal aspect.



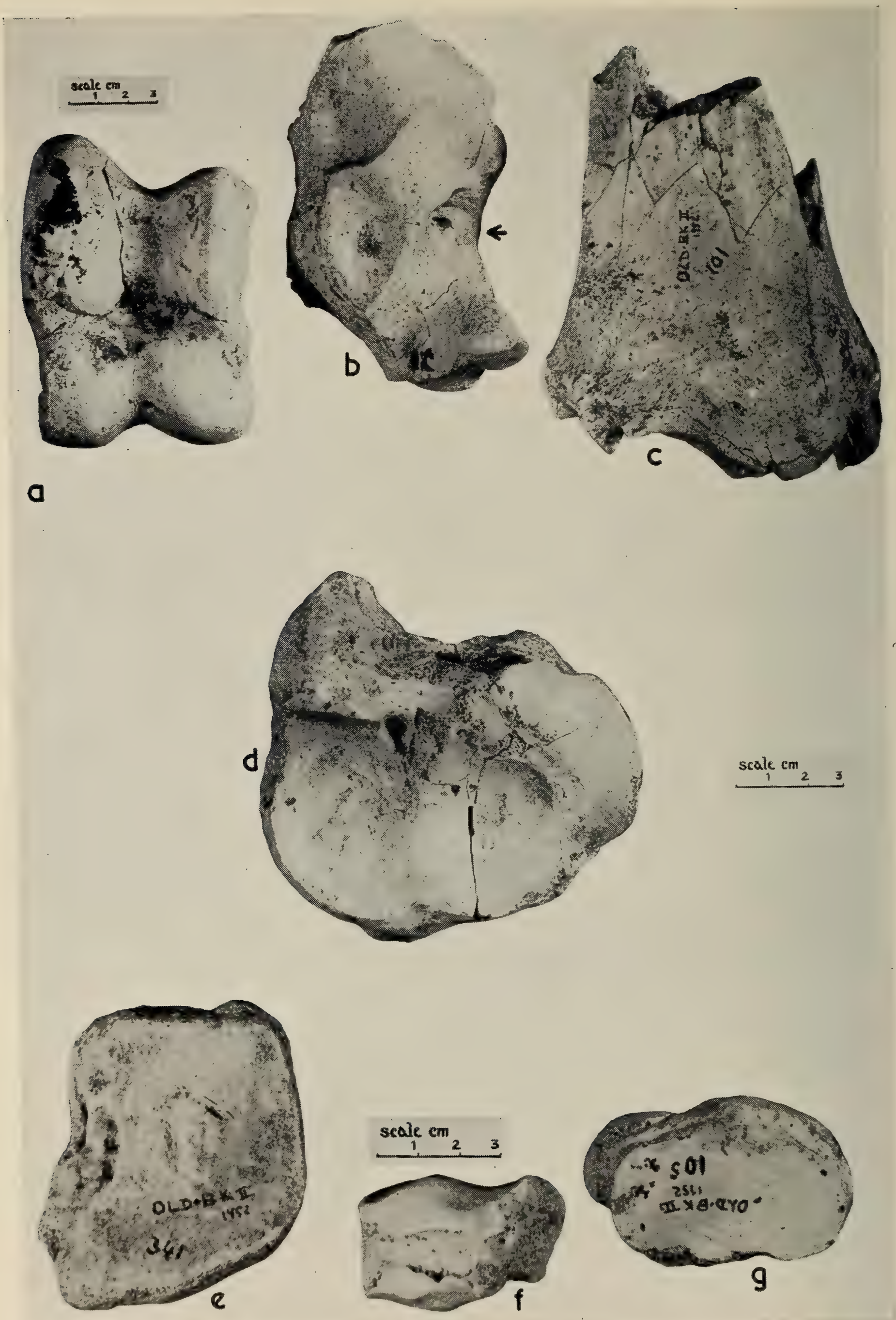
a—Old. F 2991, buccal aspect. *b*—Old. 95, buccal aspect. *c*—Old. 105, buccal aspect. *d*—Old. 166, buccal aspect. *e*—Old. 120, buccal aspect. *f*—'Old. surface', buccal aspect.



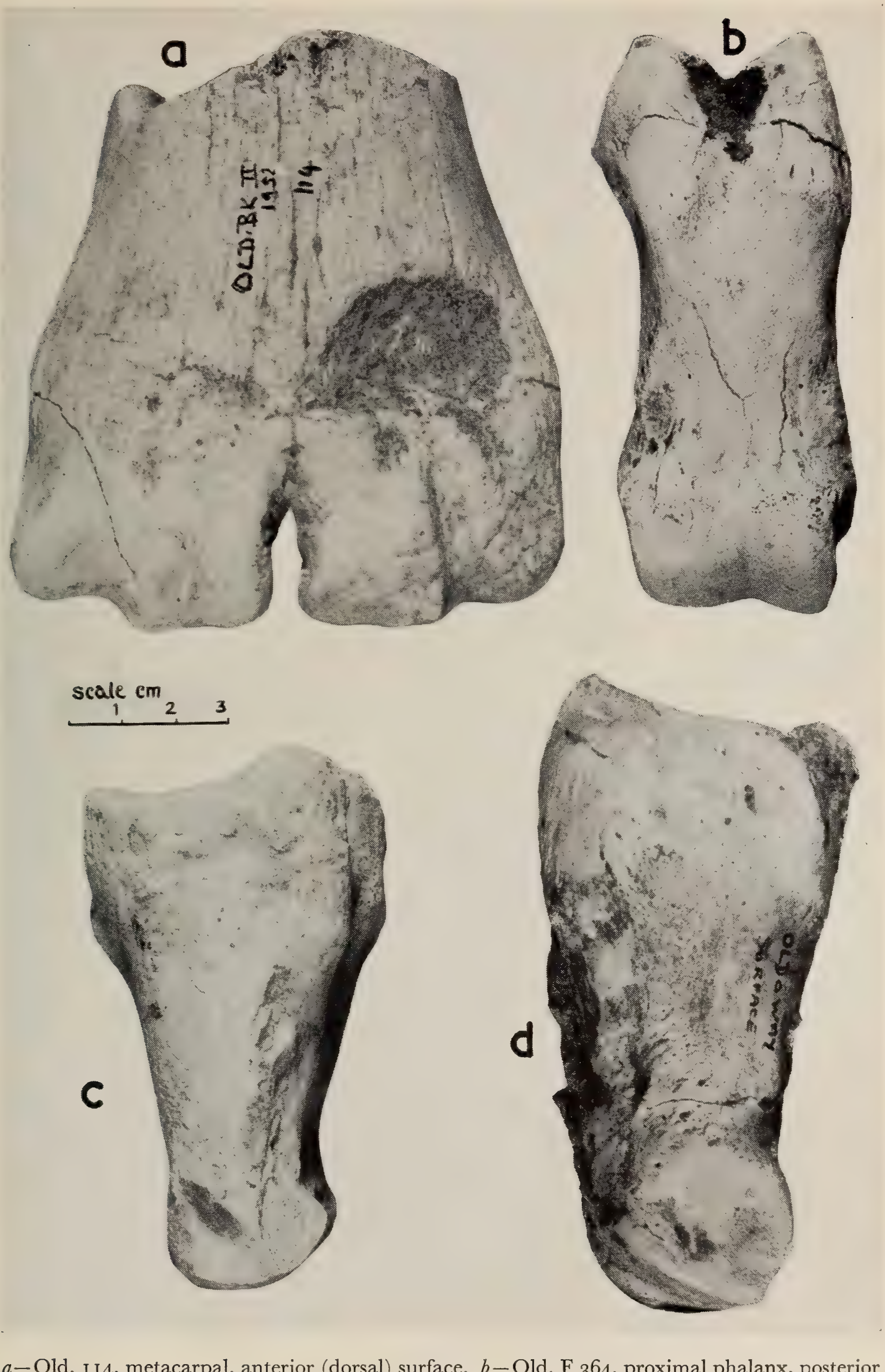
a—Old. F 2991, lingual aspect. *b*—Old. 166, lingual aspect. *c*—Old. 105, lingual aspect. *d*—Old. 95, lingual aspect. *e*—Old. 120, lingual aspect. *f*—'Old. surface', lingual aspect.



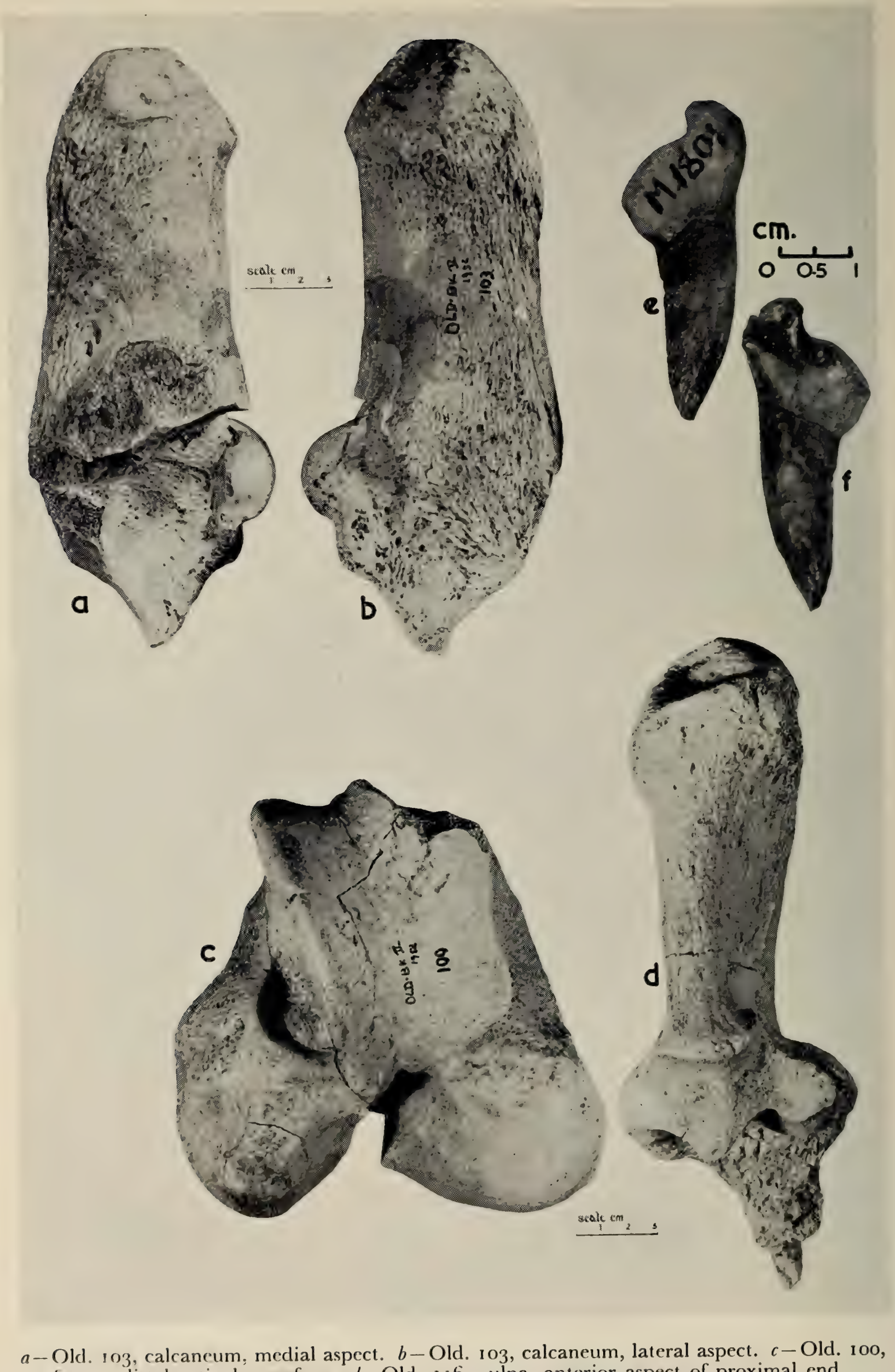
As in plate 19: occlusal aspect.



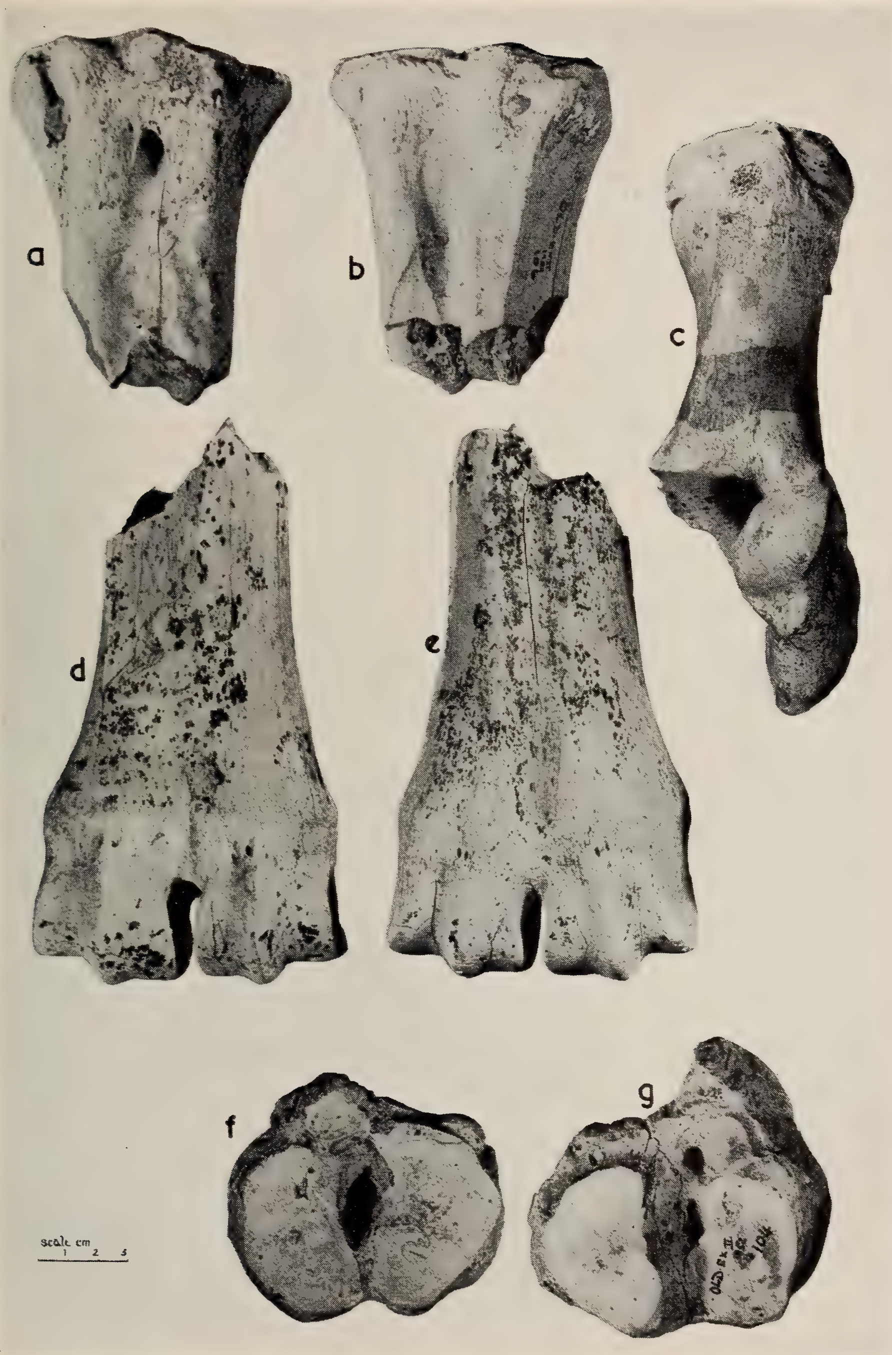
a—Old. 107, astragalus, anterior aspect. *b*—Old. 115, radius, articular surface (← indicates posterior border). *c*—Old. 101, tibia, anterior aspect. *d*—Old. 104, cubonaviculare, proximal articular surface. *e*—Old. 341, os magnum, distal articular surface. *f*—Old. 342, sesamoid bone, side view. *g*—Old. 105, cuneiform, proximal articular surface.



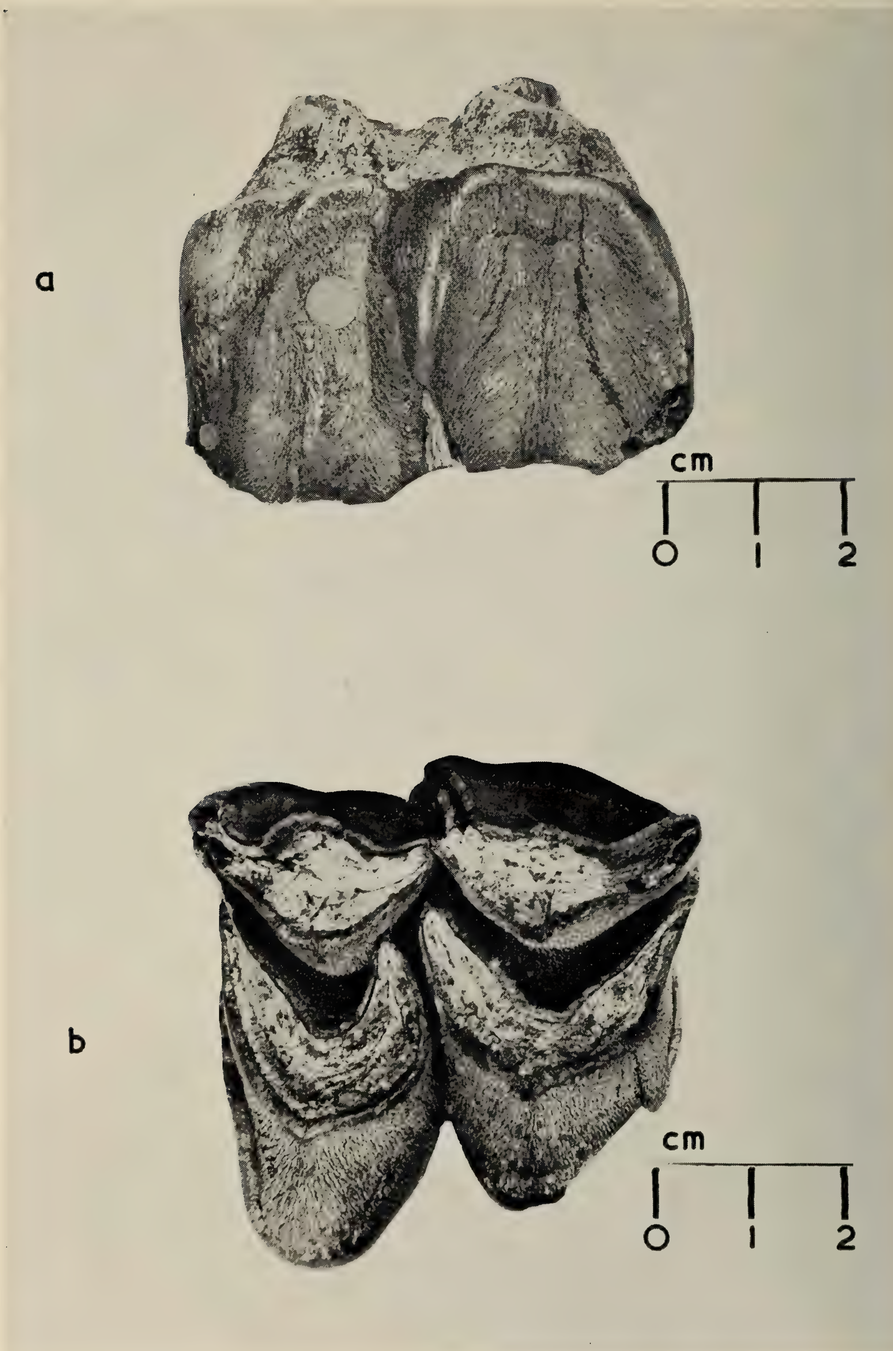
a—Old. 114, metacarpal, anterior (dorsal) surface. *b*—Old. F 364, proximal phalanx, posterior surface. *c*—Old. 185, proximal phalanx, side view. *d*—'Old. surface', proximal phalanx, side view.



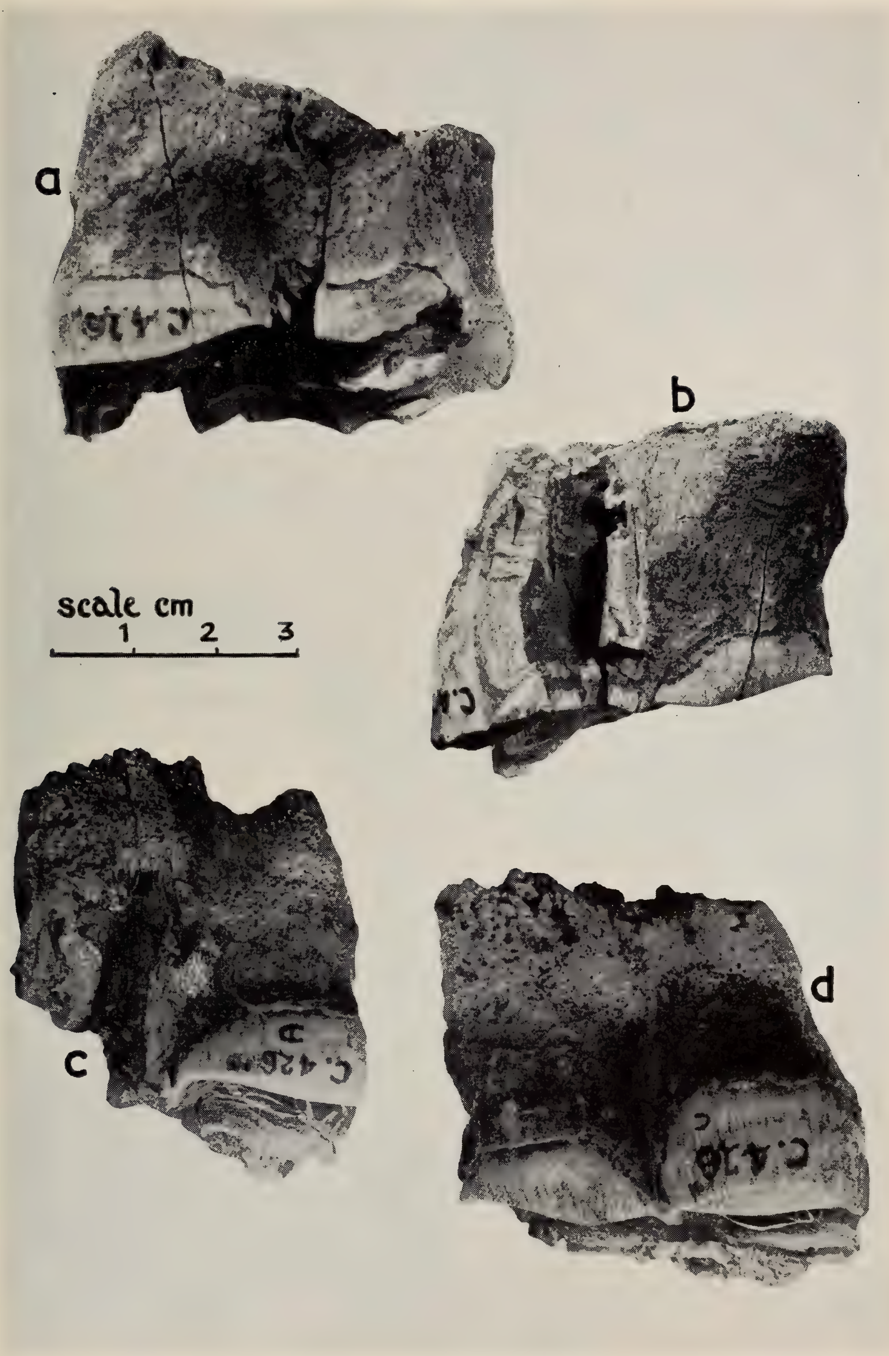
a—Old. 103, calcaneum, medial aspect. *b*—Old. 103, calcaneum, lateral aspect. *c*—Old. 100, femur, distal articular surface. *d*—Old. 116p, ulna, anterior aspect of proximal end. *e*, *f*—Makapansgat M 1801; buccal, lingual aspects respectively.



a—Old. 106, metatarsal, posterior aspect of proximal end. *b*—Old. 106, metatarsal, anterior aspect of proximal end. *c*—Old. 103, calcaneum, anterior aspect. *d*—Old. 314, metatarsal, posterior aspect of distal end. *e*—Old. 314, metatarsal, anterior aspect of distal end. *f*—Old. 106, metatarsal, proximal articular surface. *g*—Old. 104, cubonaviculare, distal articular surface.

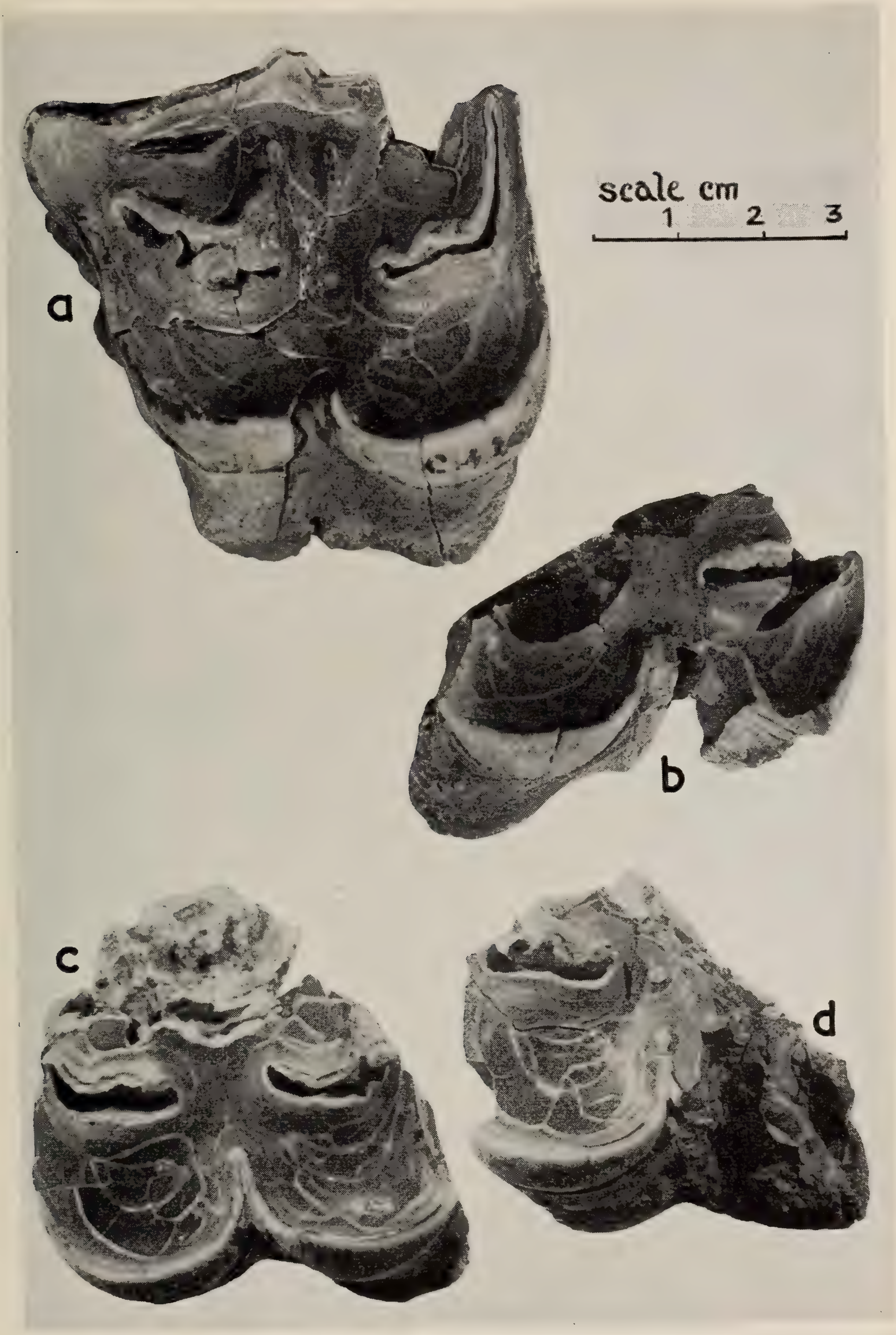


MMK 3685 (O.F.S.): *a*, *b*—buccal and occlusal aspects respectively.



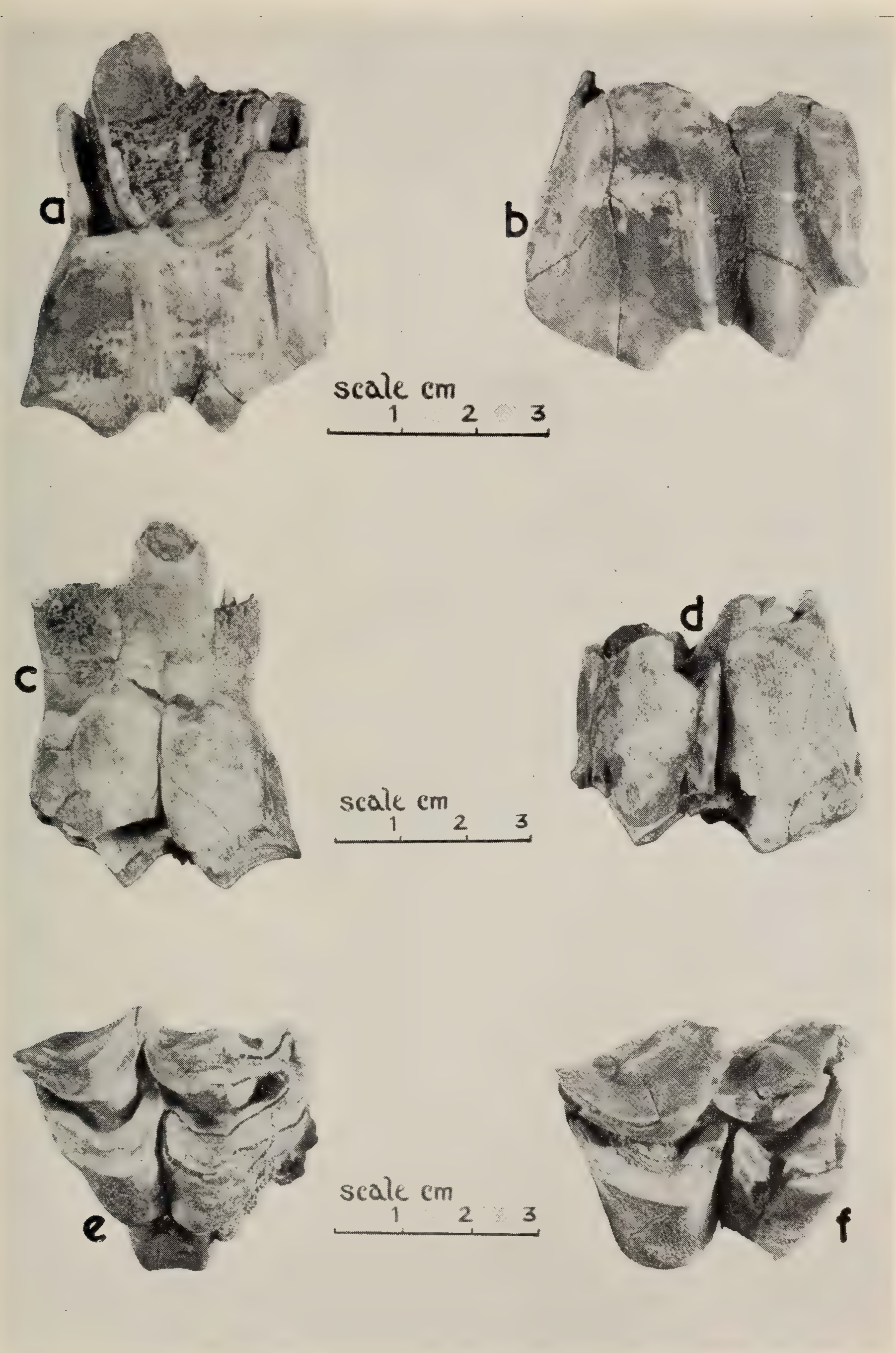
a—C. 426A (O.F.S.), lingual aspect. *b*—C. 426B (O.F.S.), lingual aspect.
c—C. 426D (O.F.S.), lingual aspect. *d*—C. 426C (O.F.S.), lingual aspect.

a—C. 426A, buccal aspect. *b*—C. 426B, buccal aspect. *c*—F. 39 (O.F.S.), X-ray (antero-posterior). *d*—F. 39 (O.F.S.), posterior aspect. *e*—F. 39 (O.F.S.), buccal aspect.

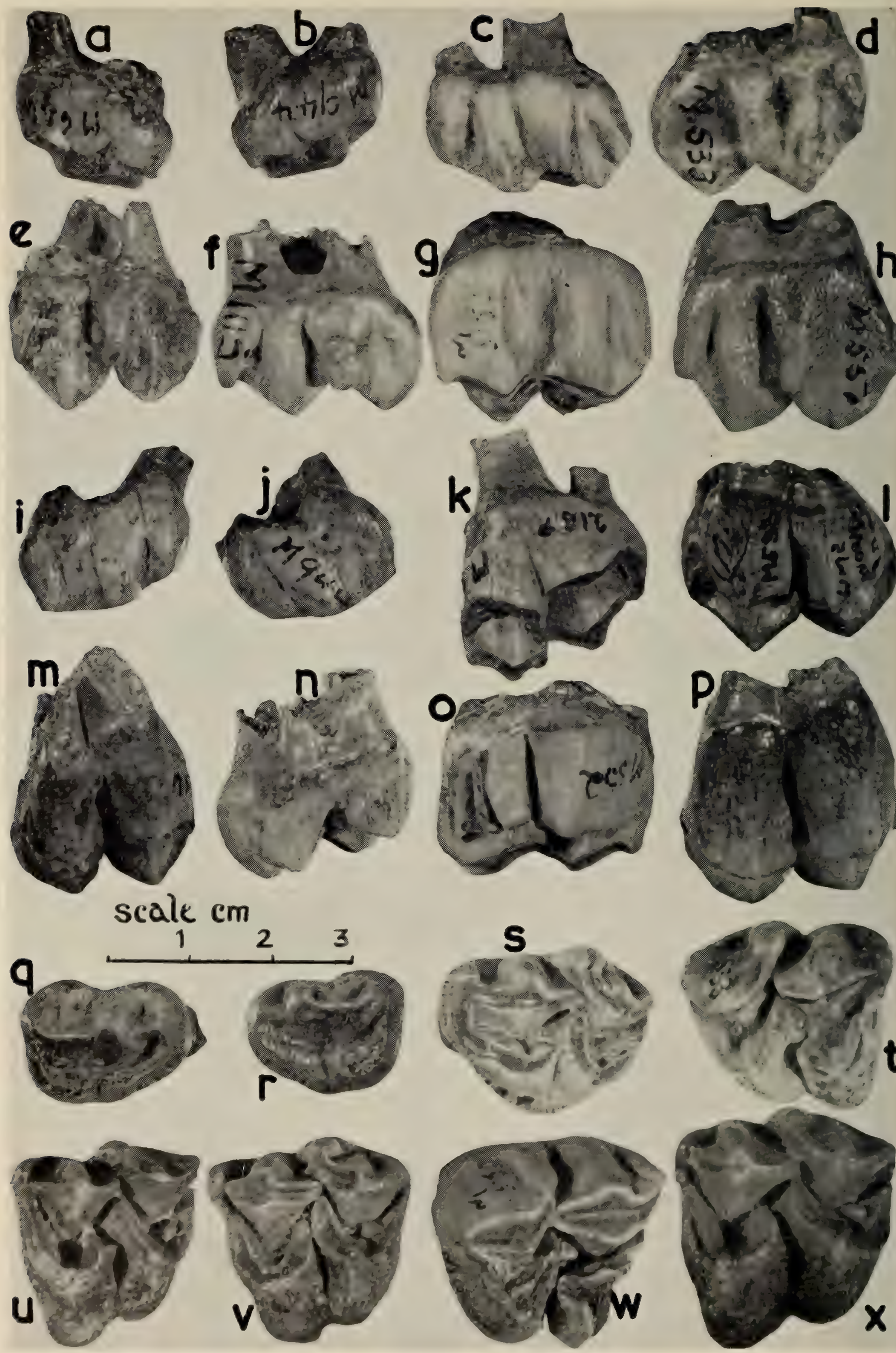


a—C. 426A, occlusal aspect. *b*—C. 426B, occlusal aspect. *c*—C. 426C, occlusal aspect. *d*—C. 426D, occlusal aspect.

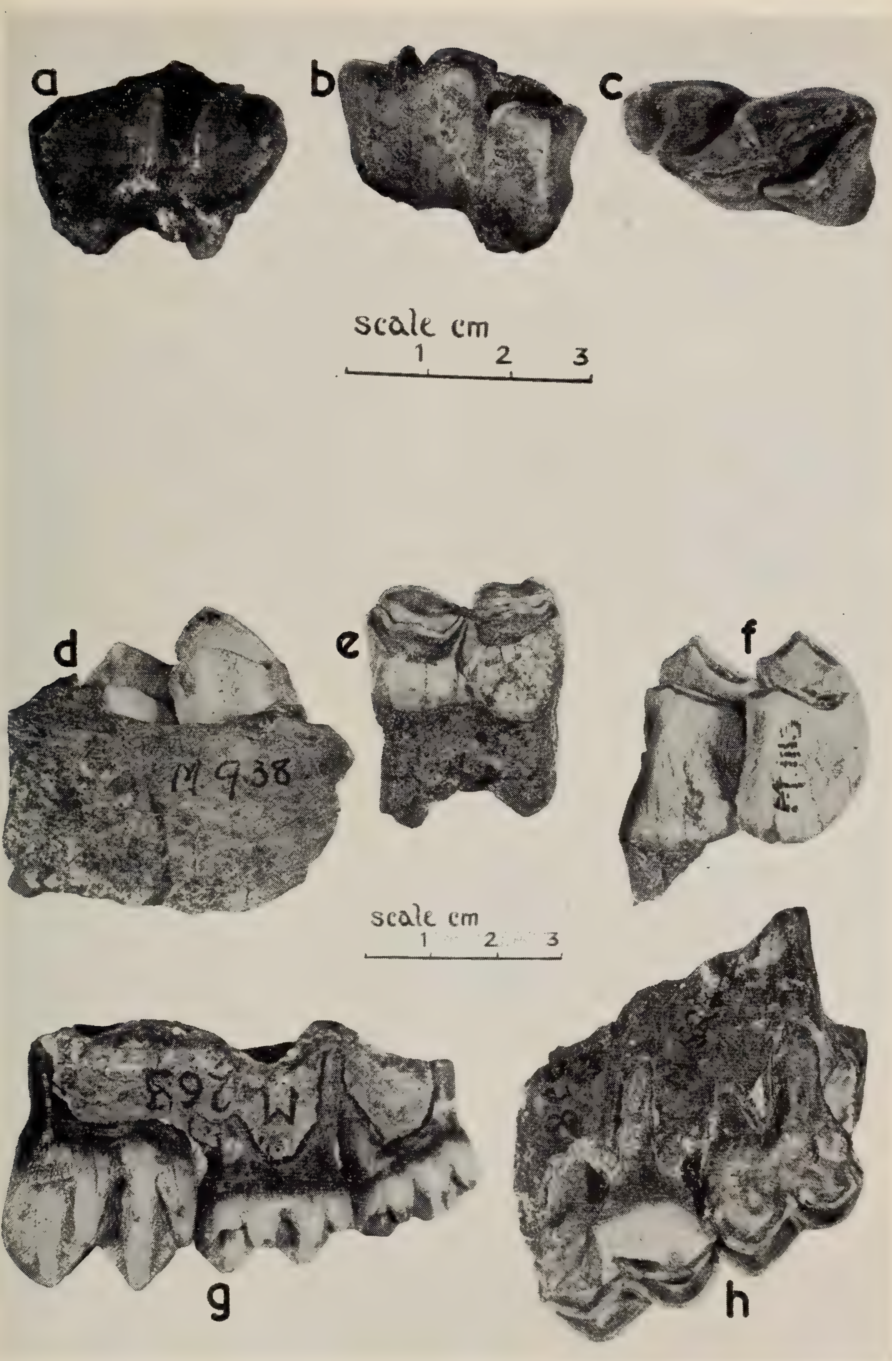
a—C. 431B, lateral aspect. Note cranial sinuses in base. *b*—C. 431B, medial aspect. *c*—C. 431A, anterior view. *d*—C. 431A, antero-medial aspect.



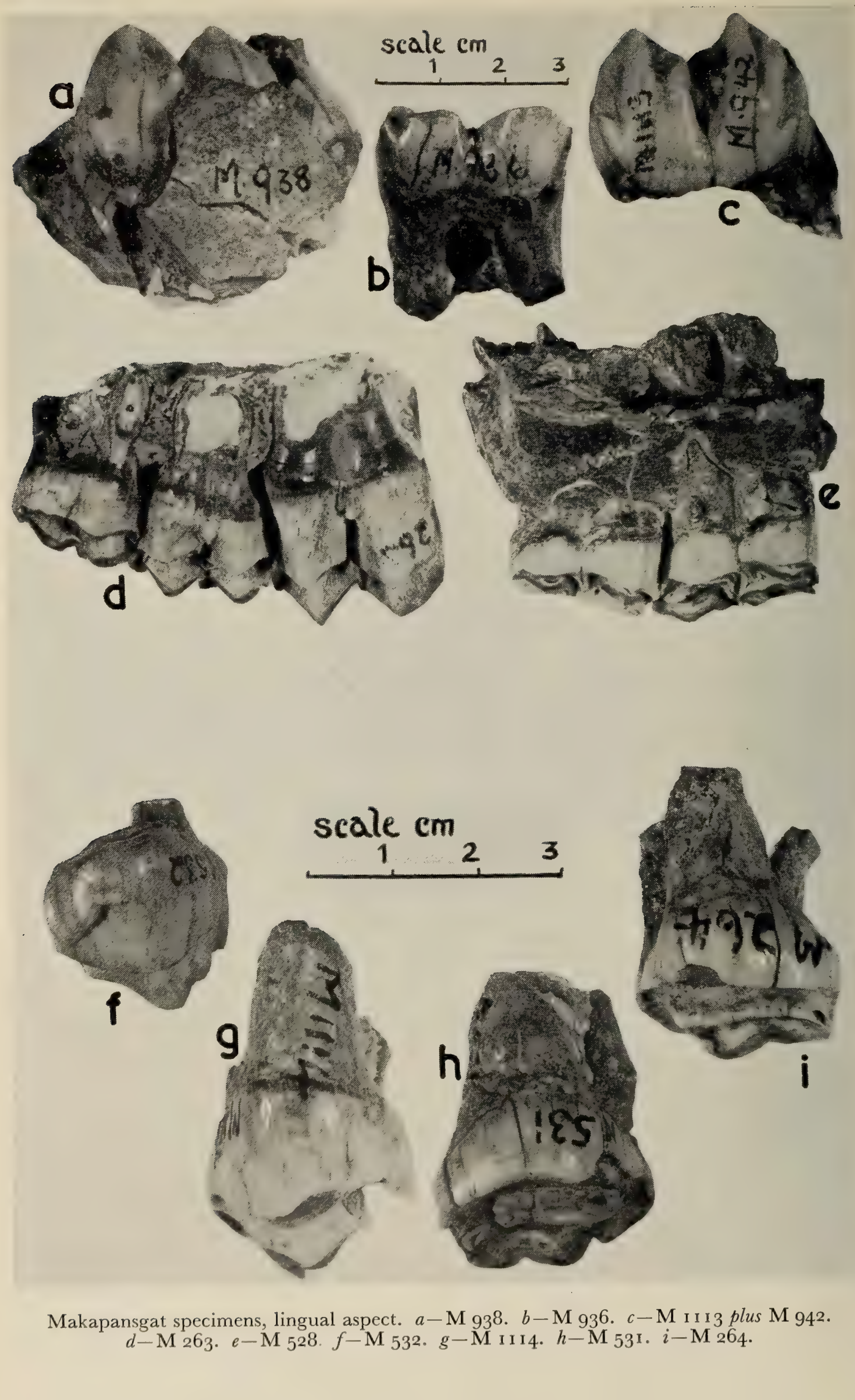
a, c, e—B[1] (O.F.S.), buccal, lingual, occlusal aspects respectively.
b, d, f—B[2] (O.F.S.), buccal, lingual, occlusal aspects respectively.



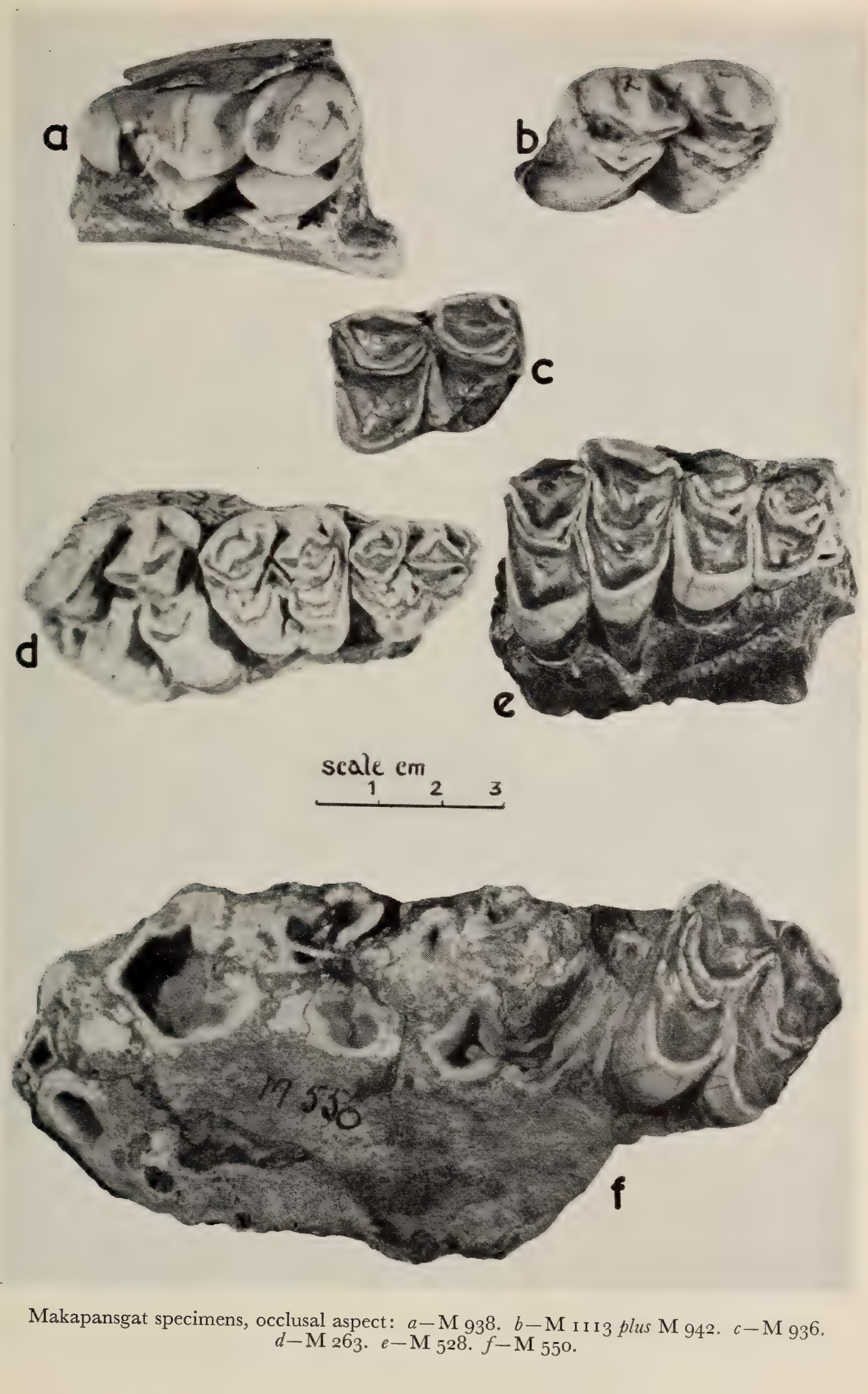
Makapansgat specimens: *a*, *i*, *q*—M 646, buccal, lingual, occlusal aspects respectively. *b*, *j*, *r*—M 944, buccal, lingual, occlusal aspects respectively. *c*, *k*, *s*—M 536, buccal, lingual, occlusal aspects respectively. *d*, *l*, *t*—M 533, buccal, lingual, occlusal aspects respectively. *e*, *m*, *u*—M 535, buccal, lingual, occlusal aspects respectively. *f*, *n*, *v*—M 1115, buccal, lingual, occlusal aspects respectively. *g*, *o*, *w*—M 552, buccal, lingual, occlusal aspects respectively. *h*, *p*, *x*—M 551, buccal, lingual, occlusal aspects respectively.



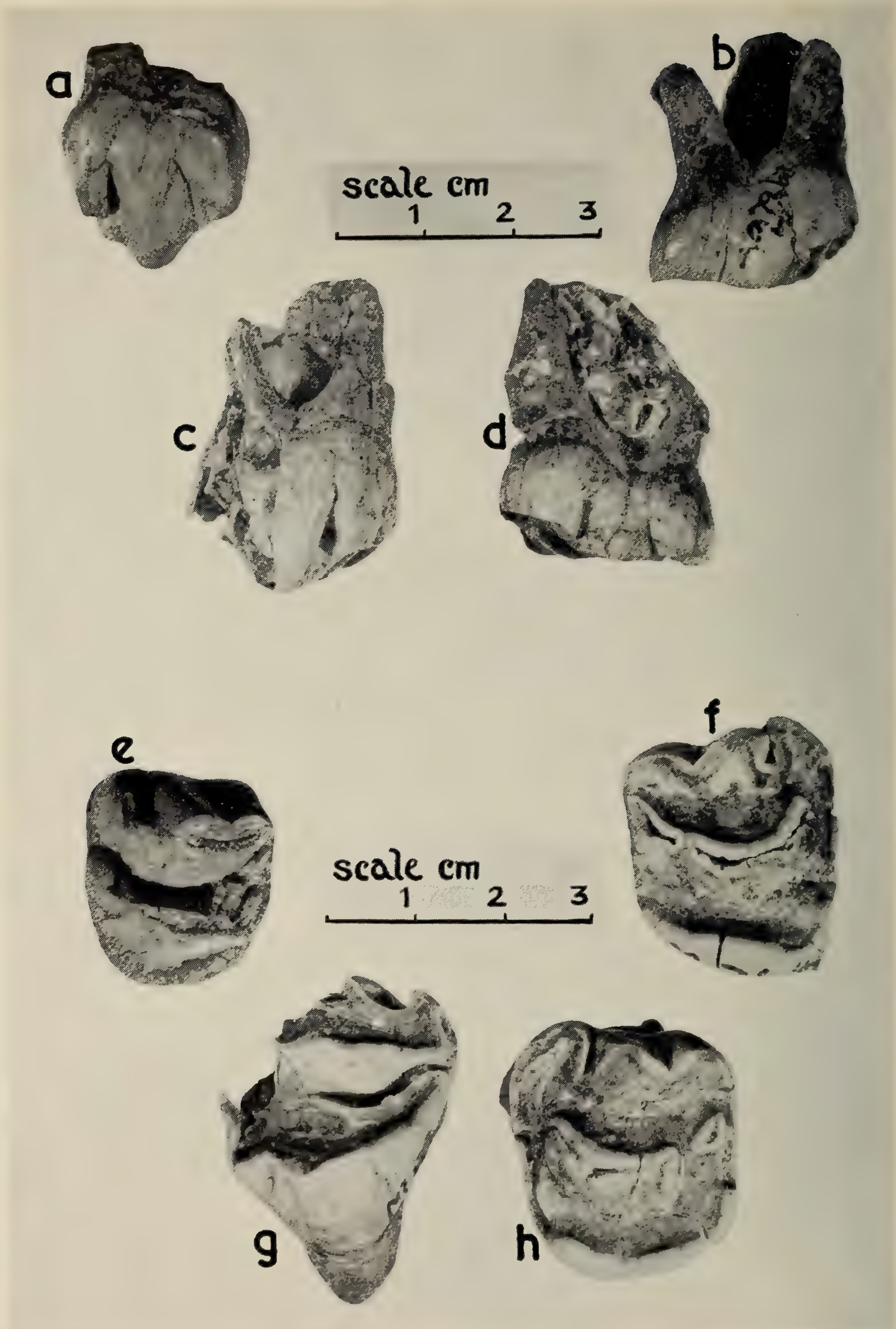
Makapansgat specimens: *a*, *b*, *c*—M 525, lingual, buccal, occlusal aspects respectively. *d*—M 938, buccal aspect. *e*—M 936, buccal aspect. *f*—M 1113 *plus* M 942, buccal aspect. *g*—M 263, buccal aspect. *h*—M 528, buccal aspect.



Makapansgat specimens, lingual aspect. *a*—M 938. *b*—M 936. *c*—M 1113 *plus* M 942. *d*—M 263. *e*—M 528. *f*—M 532. *g*—M 1114. *h*—M 531. *i*—M 264.

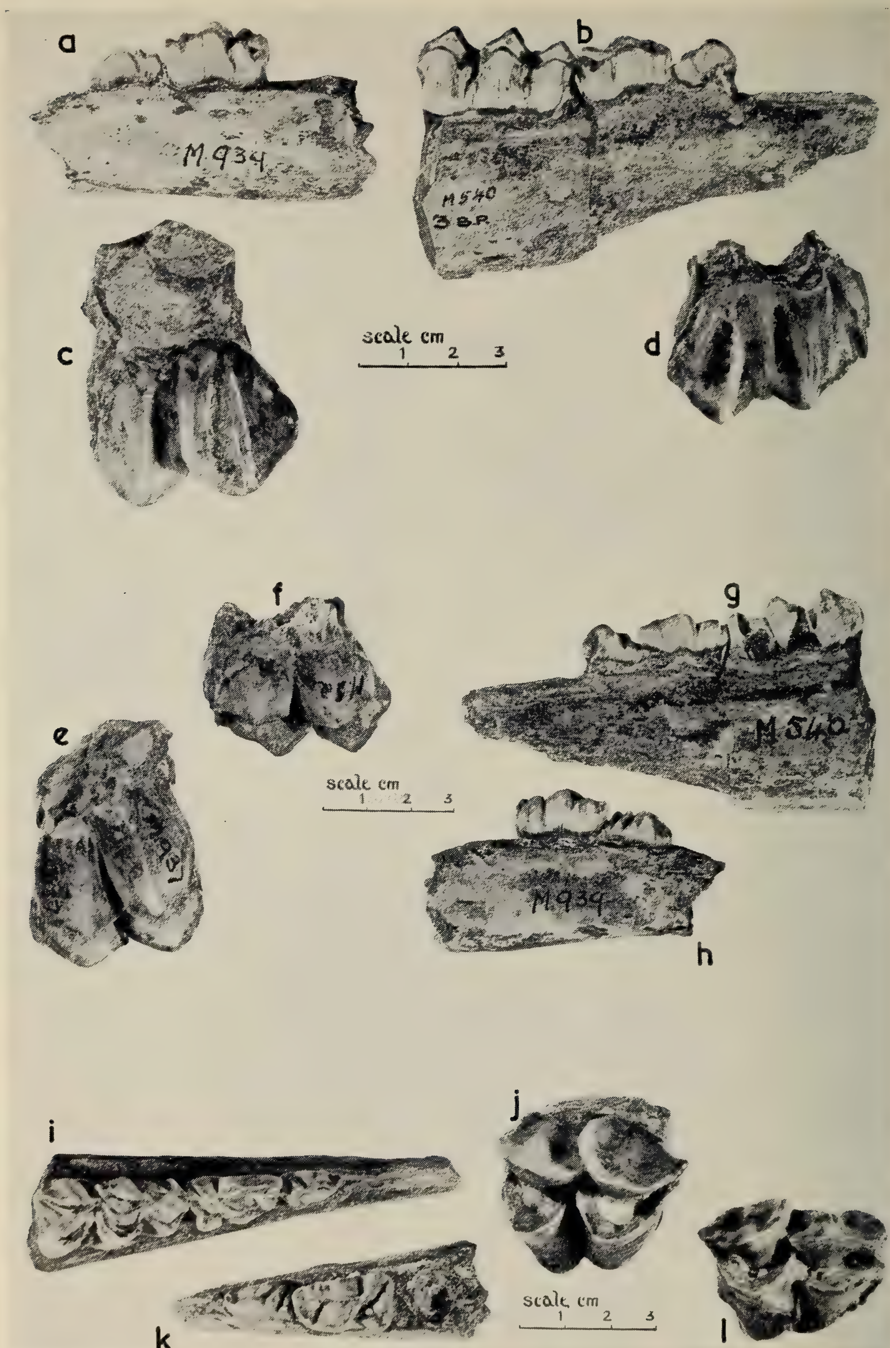


Makapansgat specimens, occlusal aspect: *a*—M 938. *b*—M 1113 *plus* M 942. *c*—M 936. *d*—M 263. *e*—M 528. *f*—M 550.

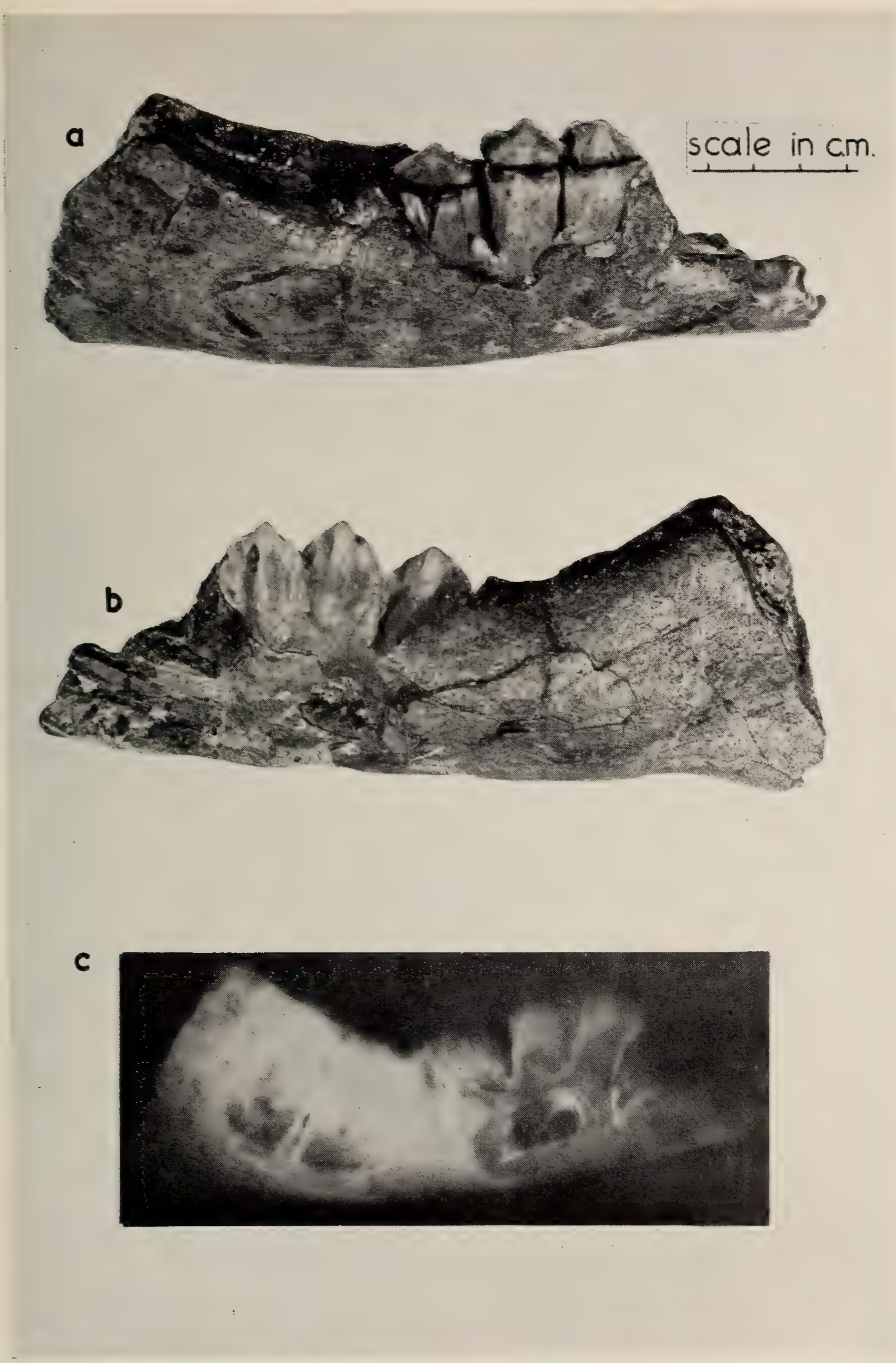


Makapansgat specimens: *a*, *e*—M 532, buccal and occlusal aspects respectively. *b*, *f*—M 264, buccal and occlusal aspects respectively. *c*, *g*—M 1114, buccal and occlusal aspects respectively. *d*, *h*—M 531, buccal and occlusal aspects respectively.

Makapansgat specimens: *a*, *b*, *c*—M 527, buccal, lingual, occlusal aspects respectively. *d*, *e*, *f*—M 1116, buccal, lingual, occlusal aspects respectively. *g*—cast of M 539A, now in B.M.N.H. and numbered M 16729. Bucco-occlusal view.



Makapansgat specimens: *a*, *h*, *k*—M 939, buccal, lingual, occlusal aspects respectively. *b*, *g*, *i*—M 540, buccal, lingual, occlusal aspects respectively. *c*, *e*, *j*—M 937, buccal, lingual, occlusal aspects respectively. *d*, *f*, *l*—M 524, buccal, lingual, occlusal aspects respectively.

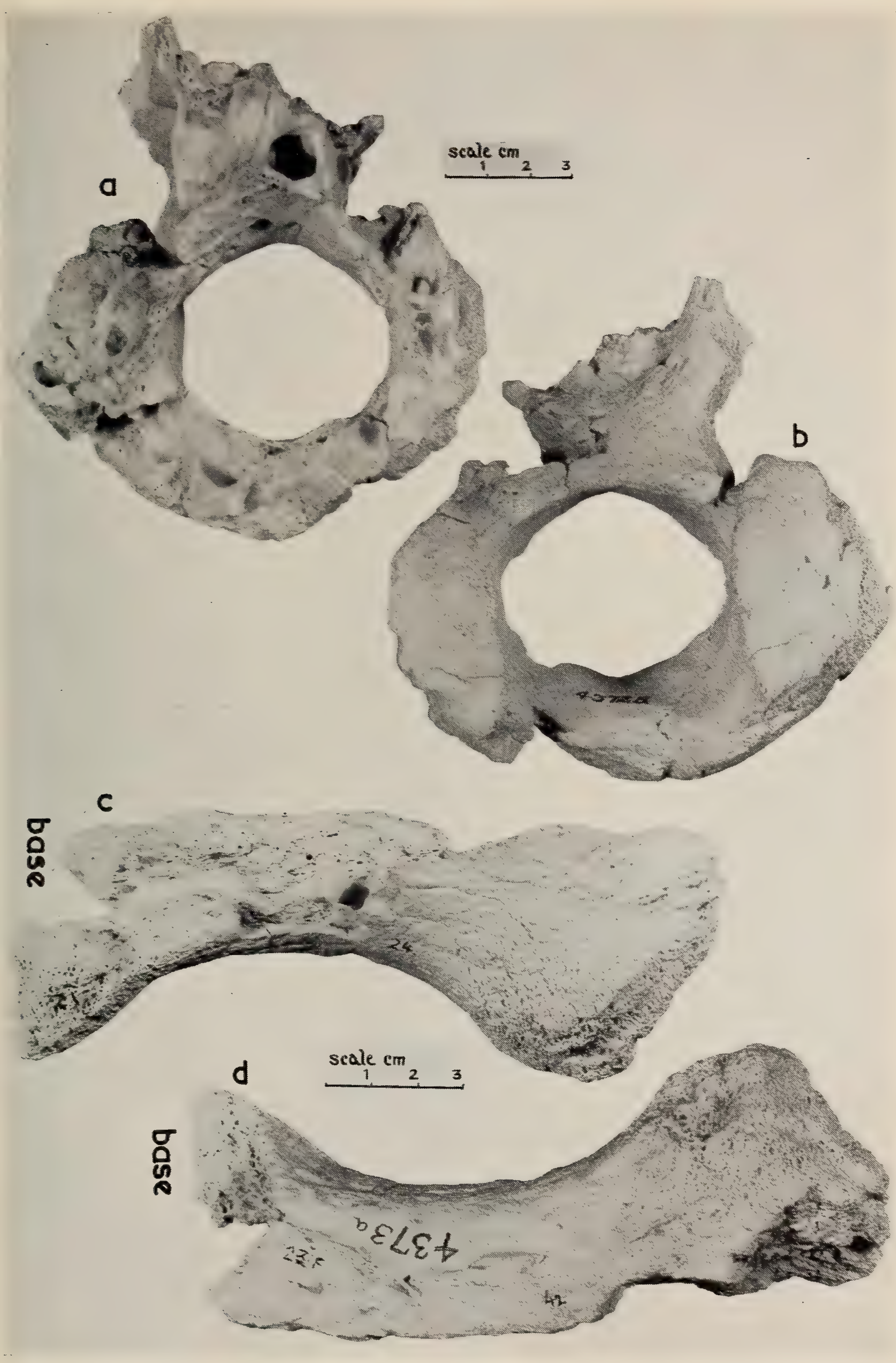


Makapansgat M539B: *a*—bucco-occlusal aspect. *b*—lingual aspect. *c*—X-ray.

Makapansgat specimens: *a*, *b*—M 553A, buccal (lateral), lingual (medial) aspects respectively. *c*, *d*—M 553B, lingual, occlusal aspects respectively.

M 553A *plus* M 2087 (joined): *a*—shows buccal aspect of M 2087 and lingual aspect of M 553A (inferior border adjacent to '*a*'). *b*—inferior aspect. *c*—superior aspect.

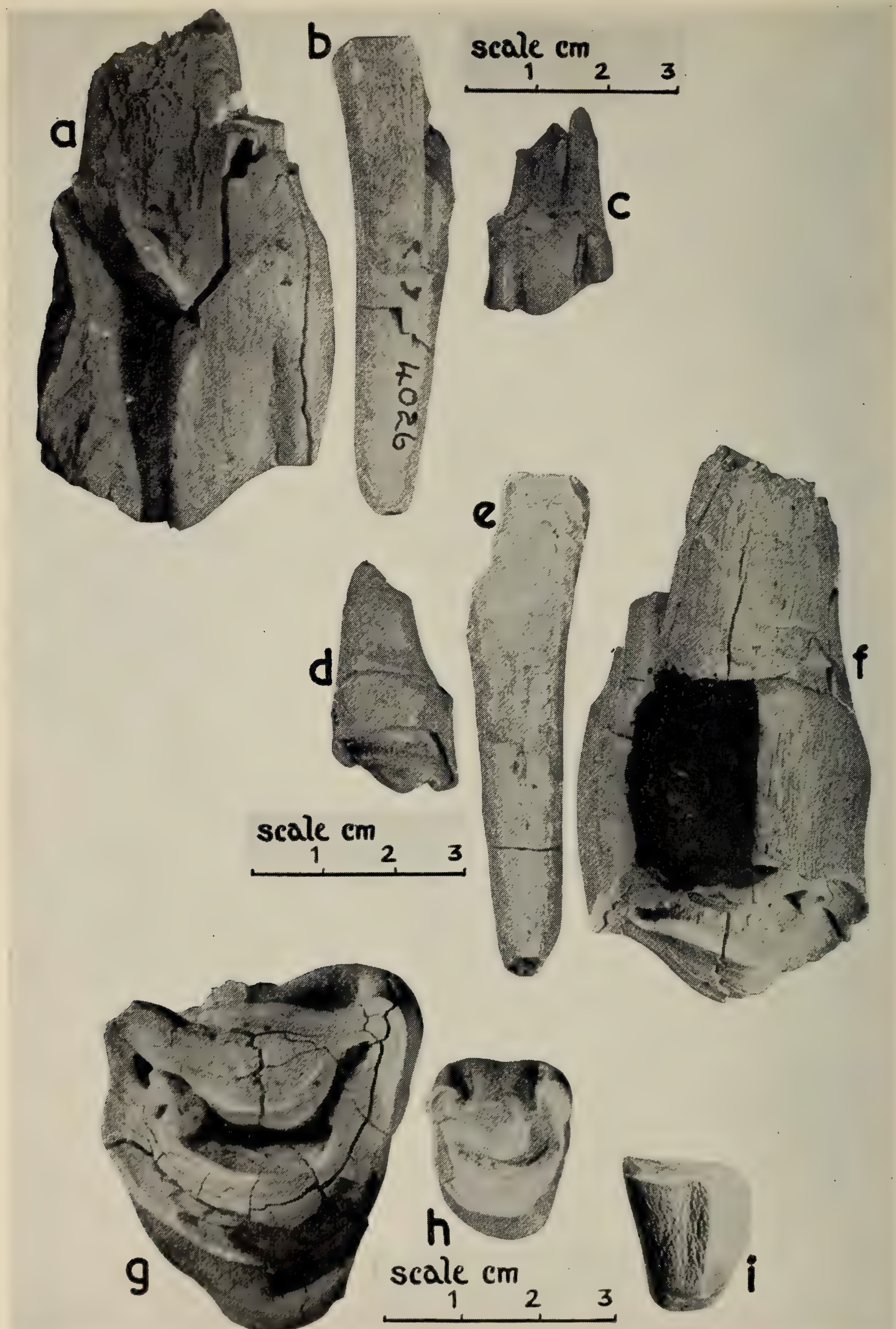
M 553B[1]: *a*—bucco-occlusal aspect. *b*—buccal aspect.



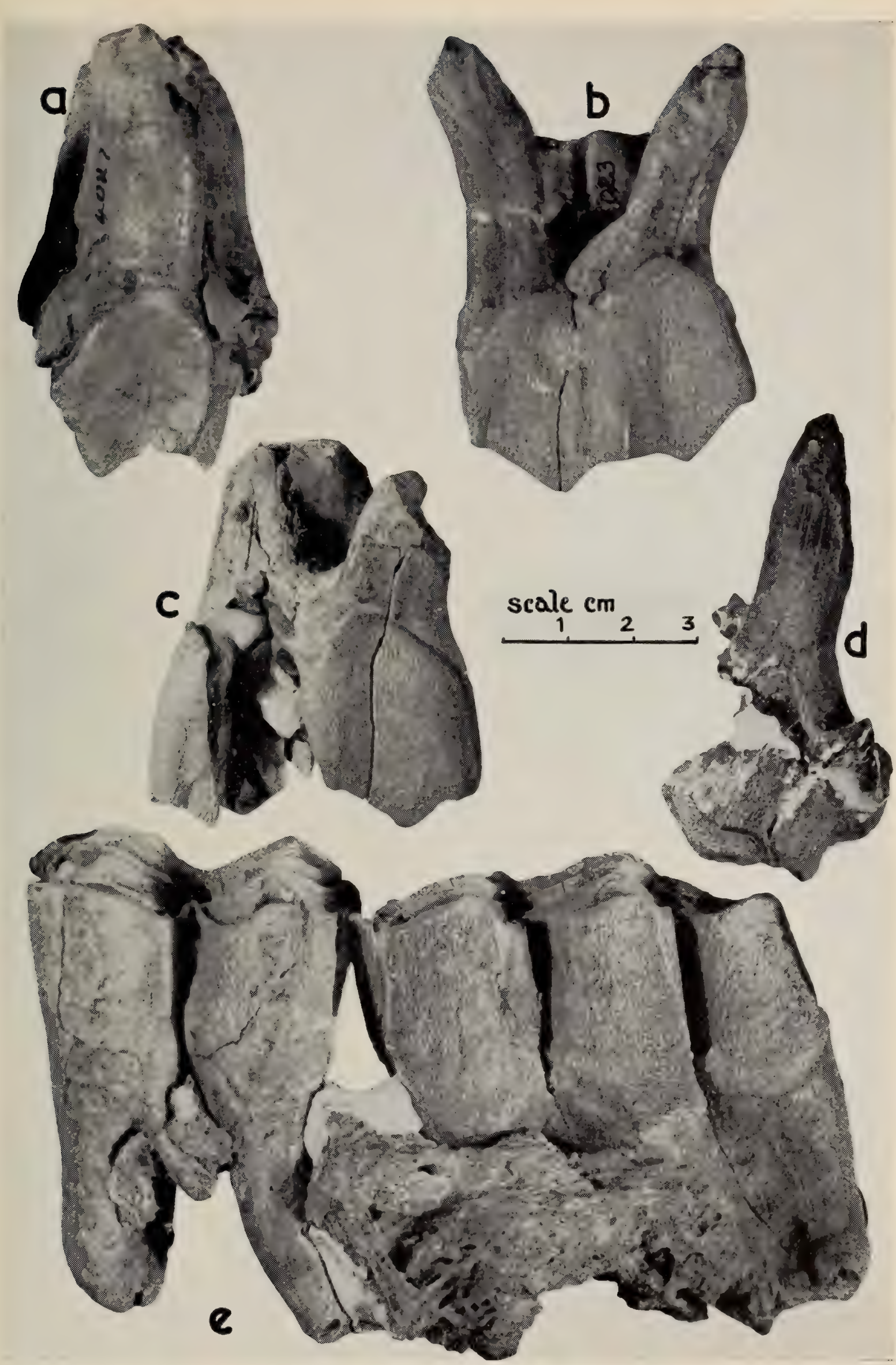
Hopefield specimens: *a*—4372B, viewed from endocranial aspect. *b*—4372B, inferior aspect: shows incomplete occipital condyles. *c*—4373A, side view. *d*—4373A, opposite side to (*c*).

Hopefield 4372. *a* – postero-lateral aspect. *b* – anterior aspect. *c* – antero-medial aspect.

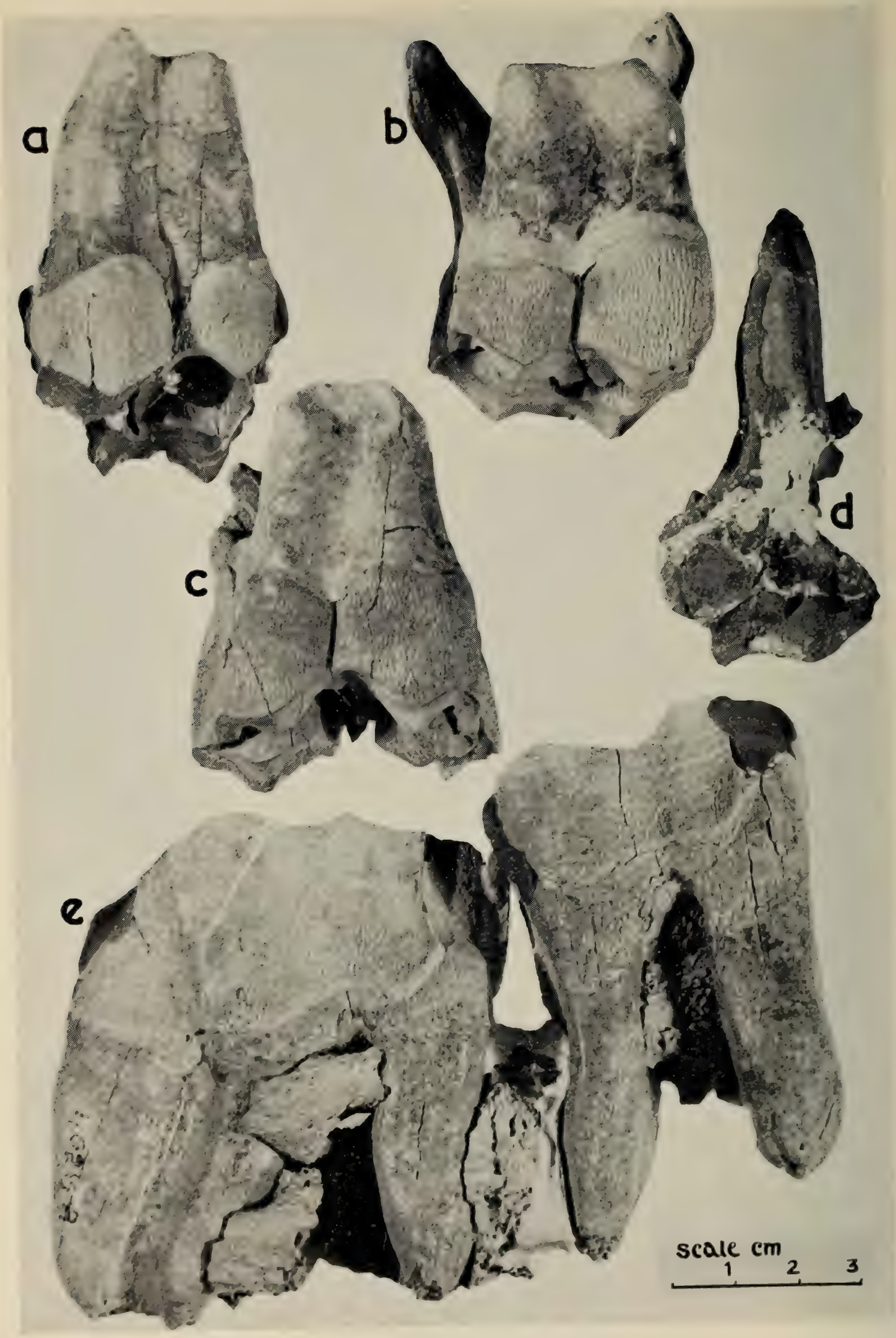
Hopefield 4373: *a*—antero-medial aspect. *b*—anterior aspect. *c*—postero-lateral aspect.



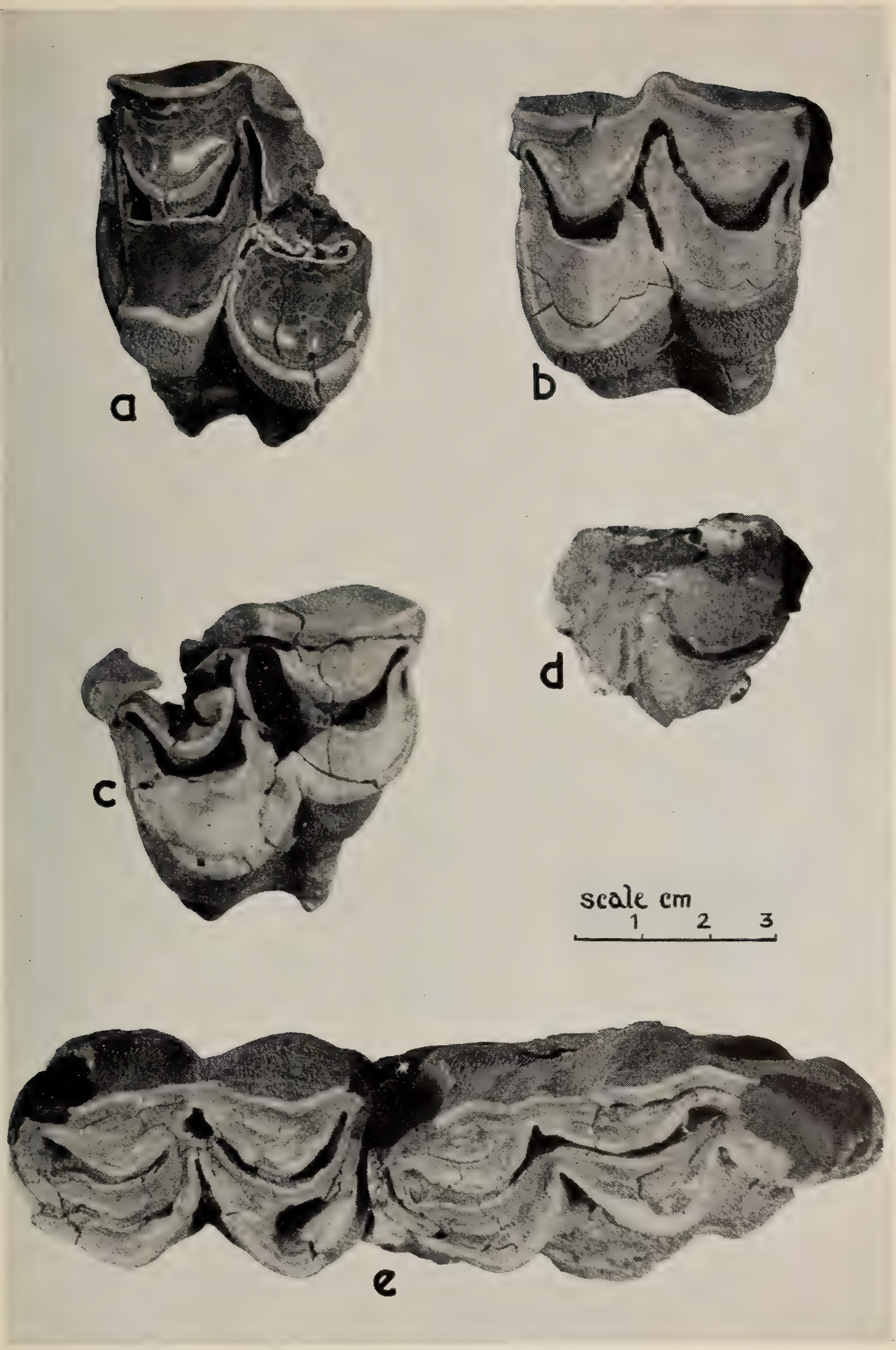
Hopefield specimens: *a*, *f*, *g*—4025, buccal, lingual, occlusal aspects respectively. *b*, *e*, *i*—4026, buccal, lingual, occlusal aspects respectively. *c*, *d*, *h*—3345, buccal, lingual, occlusal aspects respectively.



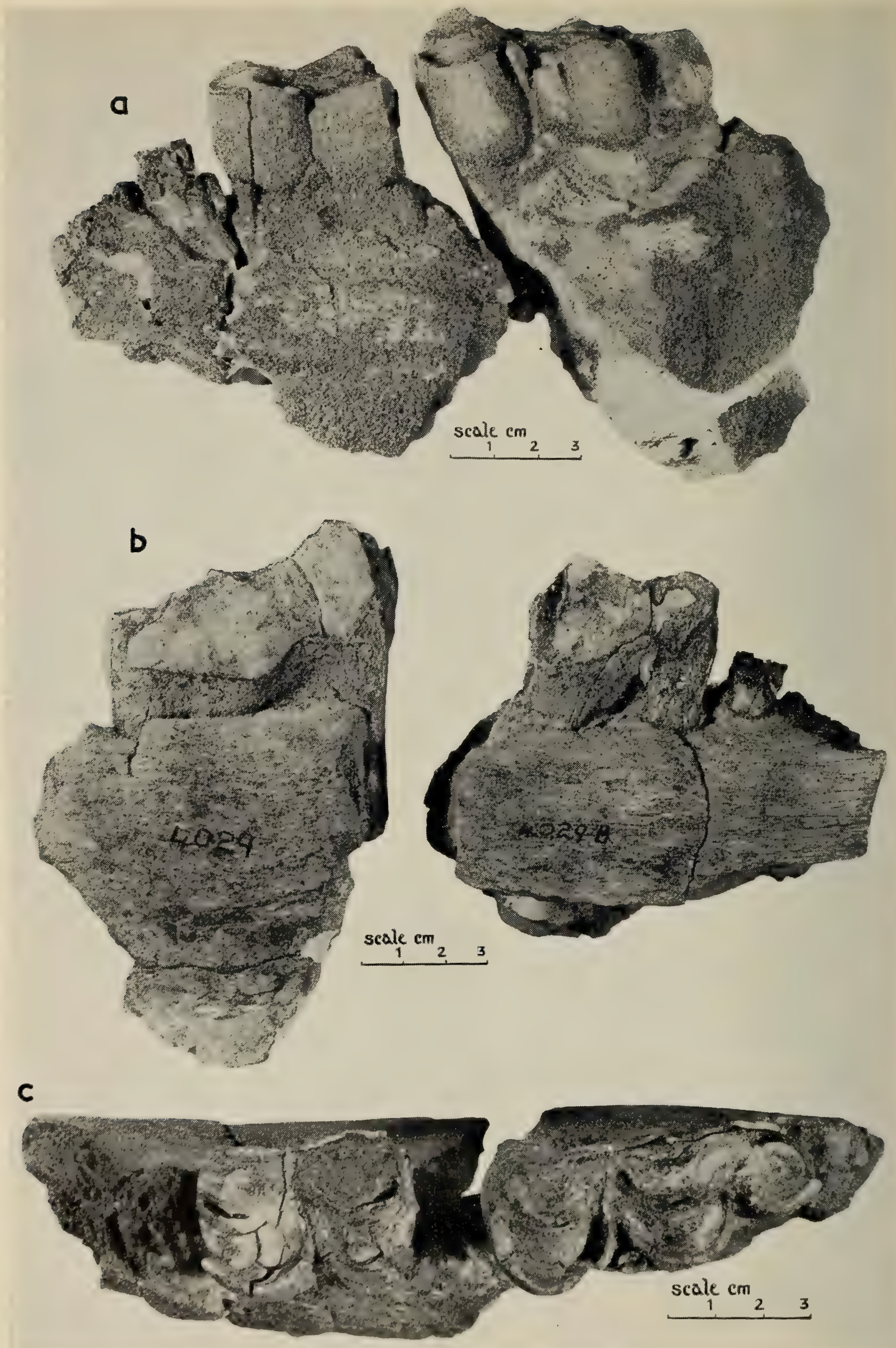
Hopefield specimens: *a*—4027, buccal aspect. *b*—4023, buccal aspect. *c*—4024, buccal aspect. *d*—4374, buccal aspect. *e*—4028 *plus* 4028A (considered as 4028), buccal aspect.



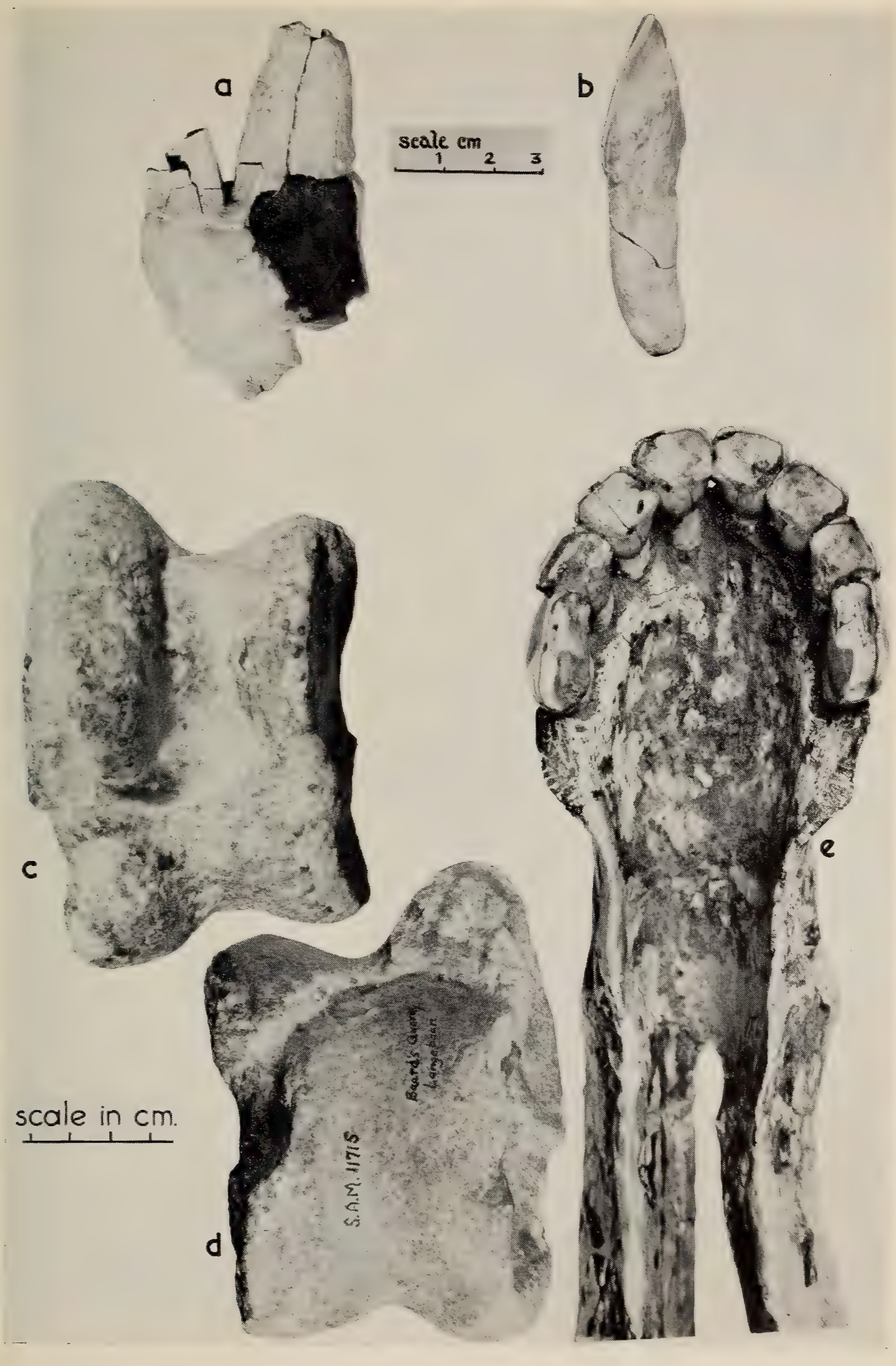
As in plate 46; lingual aspect.



As in plates 46, 47; occlusal aspect.

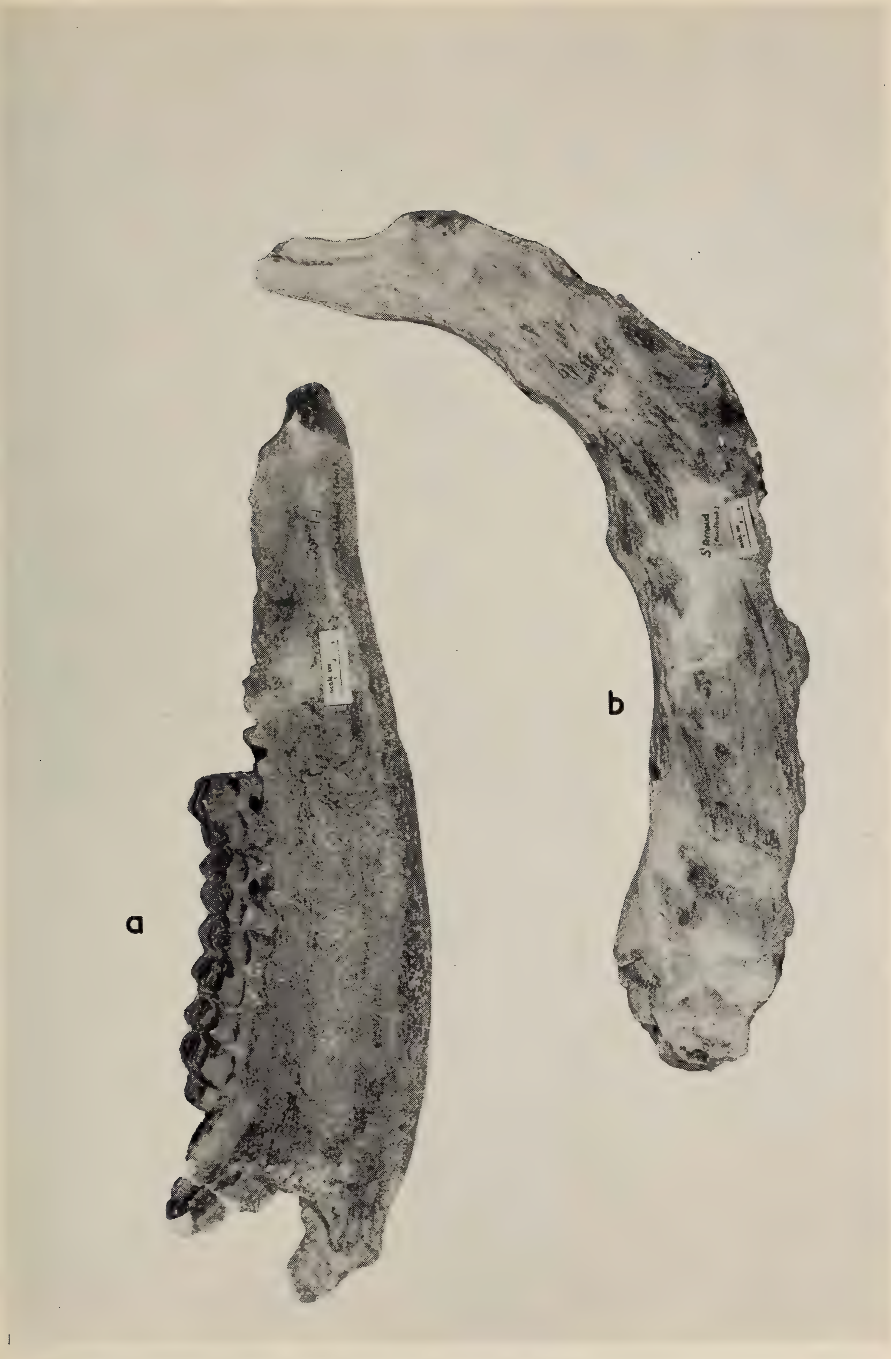


Hopefield specimens: *a*, *b*, *c*—4029 *plus* 4029B (considered as 4029), buccal, lingual, occlusal aspects respectively.

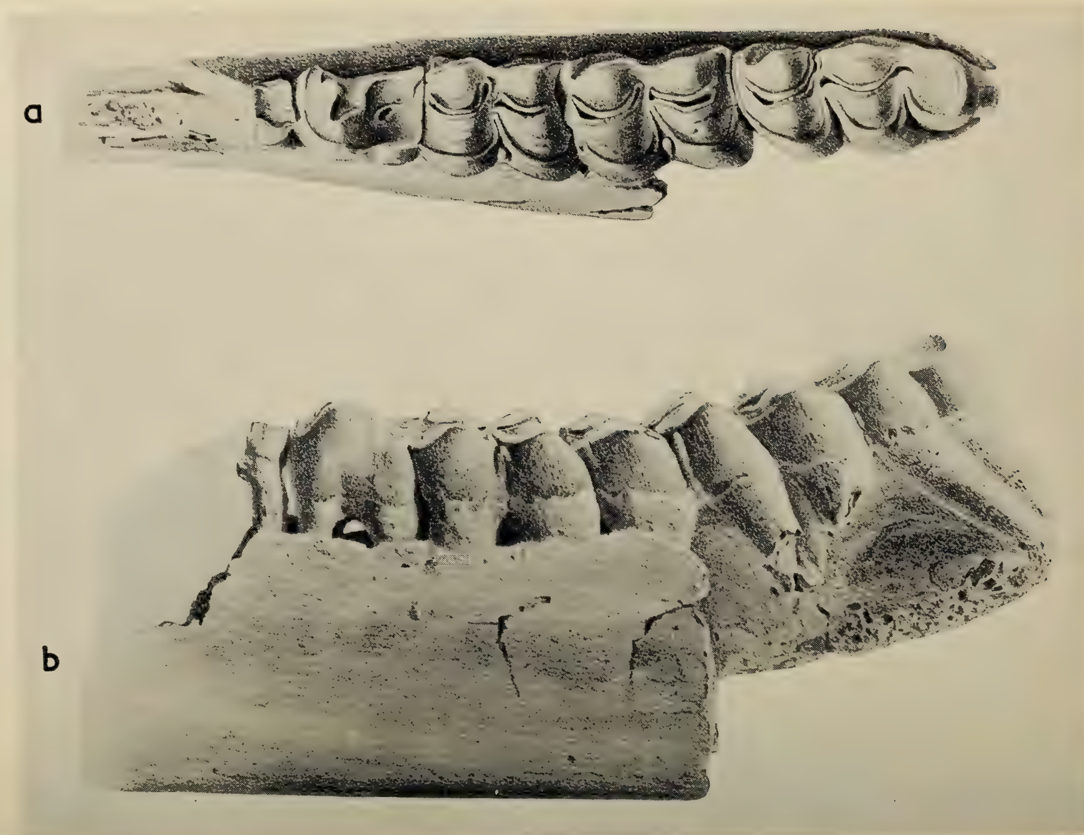


a—Hopefield 4025, posterior aspect. *b*—Hopefield 4026, mesial aspect. *c*—S.A.M. 11715 (Langebaan), astragalus, anterior aspect. *d*—S.A.M. 11715 (Langebaan), astragalus, posterior aspect. *e*—A.M. 19684 (Siwaliks, India). Mandible of *Hydaspitherium* sp. By courtesy of the American Museum of Natural History, New York.

St. Arnaud, Algeria: *a* — 1948-1-2, Mus. d'Histoire Naturelle, Paris. Antero-medial aspect of posterior horn-core of *Sivatherium olduvaiense* (described by Arambourg, 1948, as *Libytherium maurusium*). *b* — 1948-1-1, Mus. d'Histoire Naturelle, Paris. Medial aspect. (By kind permission of Professor C. Arambourg.)



a—cast of 1950–1–1 from Lac Ichkeul, Tunis. Buccal aspect. (Original in Mus. d'Histoire Naturelle, Paris.) *b*—cast of posterior horn-core from St. Arnaud (Aïn Hanech). (Original in Mus. d'Histoire Naturelle, Paris.)



Occlusal (*a*) and buccal (*b*) views of type specimen of *Libytherium maurusium* Pomel.
Reproduced from Pomel, 1892.

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SOUTH AFRICAN MUSEUM

VOLUME XLV

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Notes on the Biology of the Lutjanidae (Pisces) of the East African Coast, with special reference to L. bohar (*Forskal*). By F. H. Talbot, M.Sc. (With 5 figures in the text.)

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NOTES ON THE BIOLOGY OF THE LUTJANIDAE* (PISCES) OF THE EAST AFRICAN COAST, WITH SPECIAL REFERENCE TO *L. BOHAR* (FORSKAL)

By F. H. Talbot, M.Sc.

(With 5 figures in the text)

Introduction

Lutjanid material for this study has been obtained during routine fishing from 1954 to 1957 inclusively, by the research ship M.V. *Research* and her replacement the M.V. *Manihine* of the East African Fisheries Research Organization, Zanzibar, while the author was a member of this Organization. During this period a study of bottom fishes was made, mainly in coral reef areas of from 3 to 14 fathoms, and also to a lesser extent in deeper water below the coral reef zone down to 100 fathoms. The work has centred on the reefs off Lamu on the Kenya coast, in the Mafia Archipelago off the Tanganyika coast, and on Latham Bank, a shallow bank surrounding a small island south-west of Zanzibar (see fig. 1). Handlines, gill-nets, trammel-nets, set-lines, basket-traps, underwater spearing, and explosives have been used for collecting. In addition fish were occasionally obtained from the local markets on Zanzibar Island. Information on Lutjanids from the unpublished East African Marine Fisheries Research Organization records from 1951 to 1953, and for 1958, has also been used by courtesy of the Director.

This paper is one of a series on hydrographic conditions, Newell (1957, 1959); fish systematics, Morgans (1958), Talbot (1957, 1958), Talbot and Williams (1956), Williams (1958a, 1959a and b); and fish biology, Talbot and Newell (1956), Williams (1953, 1956, 1958b), Williams and Newell (1957), providing some preliminary data on the systematics, distribution and biology of East Coast fishes of economic importance. A full description of the topography of the area is given in Williams, 1956. In this paper the systematics of the genus *Pristipomoides* is based on Smith (1954) and the systematics of the genus *Lutjanus* follows that used in a previous communication (Talbot, 1957).

The East African coastal area over which this study was made is markedly affected by the monsoon winds. In all seasons of the year it is bathed by the

* Both the spellings *Lutjanus* and *Lutianus* are in current use. The first nomenclatorially valid use of the generic name is in Bloch, 1790, *Nat. ausl. Fische*, **4**, p. 107, in the description of *Lutjanus lutjanus*. Cuvier, 1798, *Table. elem.*, pp. 357 and 705, uses *Lutianus* (as does Bloch occasionally after this date), and this is the form used by Jordan and Everman in their *Genera of Fishes*, Stanford Univ., 1917, with the footnote 'Also spelled *Lutjanus*'. As *Lutianus* has not been universally accepted it seems better to return to the original form *Lutjanus*.

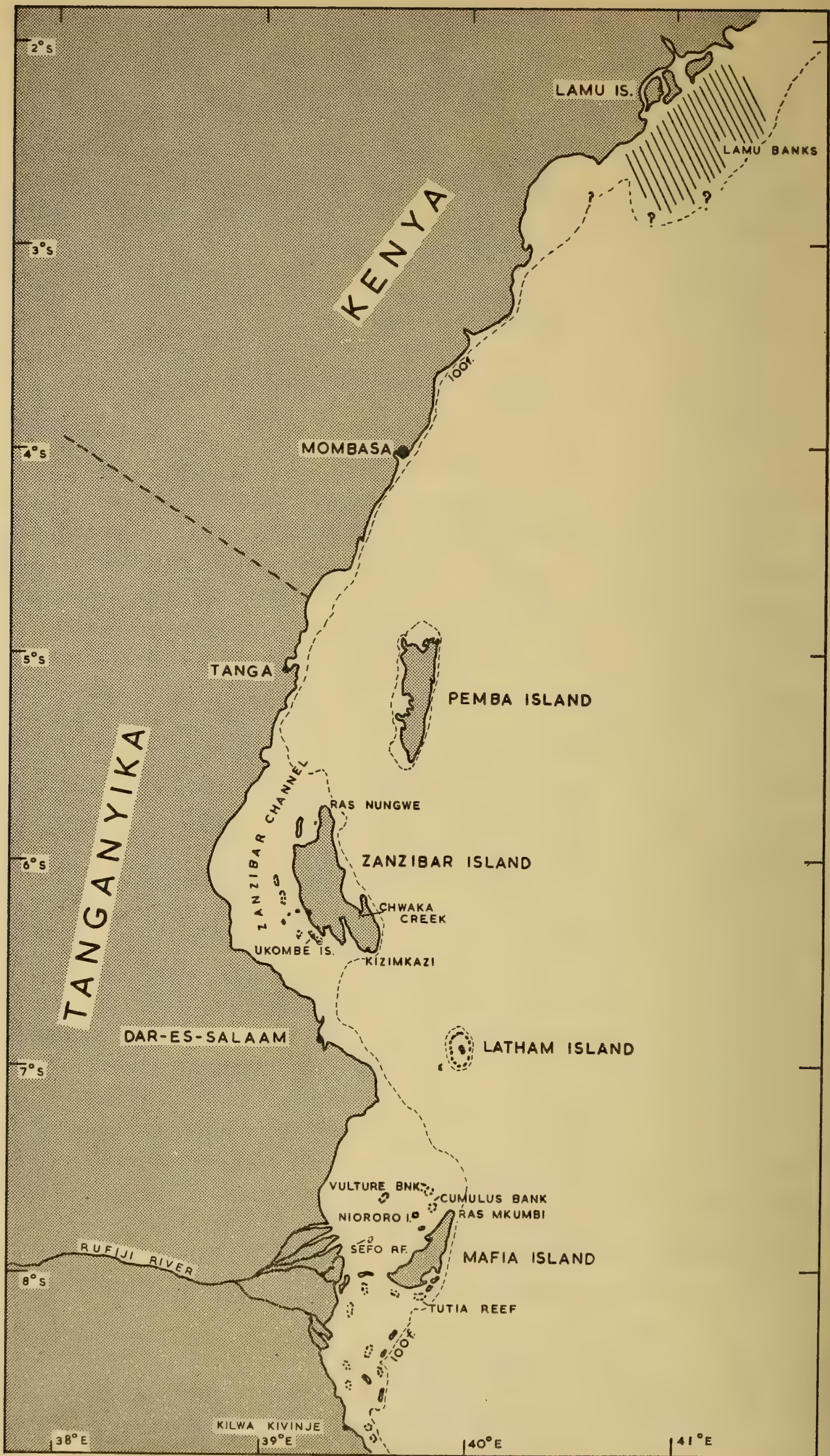

FIG. 1

Chart of the coastal areas where Lutjanids were collected. (From British Admiralty Chart 597.)

north-flowing East African Coastal Current, but from May to October ('winter', if one may talk of summer and winter so close to the equator) the strong south-east monsoon wind speeds up the current to 3–4 knots, and increases vertical mixing of the upper layers, lowering the thermocline to 50 fathoms. The surface temperature in this period is about 24°C.–25°C. In summer (November to April) the wind system is reversed, and the moderate north-east monsoon wind slows up the East African Coastal Current to 1–2 knots. Much less surfacing mixing takes place, and a very stable surface layer is formed with a marked thermocline at about 25 fathoms, and a surface temperature of 27°C.–29°C.

Although the majority of species mentioned here are widespread over the Indo-Pacific region, and many are found from the South African coast up to the Red Sea and across to Polynesia and the Tuamotu Archipelago, some 10,000 miles to the eastward, apart from systematics little or nothing has been published about their biology except some recent data on habits and habitats in systematic papers by American workers aided by U.S. Navy grants (Randall 1955, Schultz 1953, Harry 1953), and the Mauritius Seychelles Fisheries Survey undertaken by Wheeler and Ommanney (1953).

The latter authors, in a survey of the coral reef areas lying between Mauritius and Seychelles, obtained seven species of Lutjanids, all of which are also found on the East African coastline. Of these seven species four were seldom caught, but useful data were obtained on the remaining three: *L. bohar* (Forskal) (*L. civis* (C. & V.) of their report), *Aprion virescens* Valenciennes, and *L. sebae* (Cuvier).

In tropical coral areas the catches comprise many more species than do those of temperate waters, but the numbers of fish of each species are far smaller. In this survey it was difficult to obtain large enough samples of each species. With small numbers many established fishery techniques (such as deductions from length-frequency distribution) cannot be used.

Underwater observations using a Seibe-Gorman aqualung were made on Latham Bank, about Zanzibar Island, in the Zanzibar channel, and in the Mafia Archipelago, and showed that two species (*L. monostigma* and *L. vaigiensis*) were common on these reefs although they were very rarely taken by normal fishing methods. Small samples of these were collected by spear-guns. These observations also gave a much more accurate picture of relative abundance of species than did the use of handlines, nets, traps, etc., and some notes on habits were obtained. It was found that the method was strictly limited in its usefulness however, for an underwater observer with his trail of bubbles could not remain hidden, and had a marked effect on the fishes. Many of the smaller reef species are attracted by the aqualunger, who may become surrounded by shoals of small fishes. Often also the larger predators such as *Plectropomus maculatus* will come closer and inspect the unusual object from mid-water. Among the Lutjanids these effects can also be seen. *Aprion virescens* will often approach close to the diver before continuing down the reef. A shoal of

L. gibbus will move off or take shelter. *L. bohar* after a short time will usually leave the immediate reef area. Observation is therefore not of a normal undisturbed reef and its fish fauna—the 'observer' has influenced the fish population, and normal movements and feeding may not be taking place. This does not imply that the method of underwater observation is not useful. On the contrary, it is an obvious and developing method which will have important uses in ecology and ethology (see Reidle 1956). For coral reef observation however some 'hide' method must be used.

That scale rings occur in tropical marine fishes has been shown by a number of workers (summarized in Menon, 1953). The variation in surface temperatures from 24°C. to 29°C. between summer and winter in the East African area might be reasonably considered to be enough environmental change to affect the formation of annual rings. As is shown below, however, consideration of *L. bohar* scale edges with season did not bear this out.

Both scales and otoliths of *L. bohar* were examined for ringing. The otoliths showed no clear opaque and translucent zones even on grinding, and although the surface of the otoliths showed concentric ridges which gave the same counts as the scale rings in young fishes, in older fishes they were difficult to count due to crowding towards the periphery, and were also possibly covered over near the nucleus by further growth. Only the scales are therefore considered here. Scales of 273 *L. bohar* were examined, and of these approximately one in four showed rings considered clear enough to be counted, although rings of more or less clarity were present in all fish. On an average four scales per fish were counted, and scales from the same fish with few exceptions showed the same number of rings at similar relative distances from the scale nucleus. It was found that individuals of a single sample of fish, taken from the same bank at the same time did not necessarily have the outermost ring at a similar distance from the periphery, showing that the rings were not all formed at the same time of year in all fish. This suggests that the rings that do form are due to spawning, and not to seasonal changes. With checks forming at different times of year with different fish it is impossible to test whether the rings are annual by the method of watching the periphery of the scales of samples of fish periodically during the year.

Forty scales were re-read a year after first reading to check error. Of these 19 were re-read exactly as in the first reading, 12 disagreed by one year, and 9 by more than one year. These discrepancies are due to faint rings being either considered as false checks or true annuli. This error can be stated thus: in about 47% of scales used here reading error is negligible; and in about 78% of scales an error of $\pm$ 1 ring may be present. If it is realized that the scales being read here are already only those showing the clearest rings (one-quarter of the total) it is obvious that the clarity of ringing does not approach that of many temperate species. Clark (1958) for example in the re-reading of young haddock samples by the same worker obtained 90% and 93% similarity. Nevertheless in many specimens of *L. bohar* consistent ringing is present in the

scale structure, due to some regular change in the metabolism of the fishes. It is possible that these periodic changes are not annual, but their regularity suggests that they will be found to be connected with the spawning cycle or be due to periodic feeding changes. As has been suggested above, the former is the more likely answer. Wheeler (in Wheeler and Ommanney, 1953) has suggested that *L. bohar* spawns twice a year. As will be seen in this report the results from East African coastal fish rather suggest an extended breeding season in the warmer months. Lacking evidence to the contrary the ringing here seen is considered as annual.

Description of Gonad Condition

Gonads were described macroscopically in the fresh condition as the fish were gutted on board. For females a system based on seven stages was used (after Bowers, 1954). For males five stages were discernible.

Males:
I. *Immature.* Gonad small, usually threadlike, no sperm extruded on cutting and squeezing.
II. *Mature unripe.* Gonad small, sperm extruded on cutting and squeezing.
III. *Ripe.* Gonad enlarged and full of sperm.
IV. *Ripe running.* As above, but milt extruded on pressure to flank.
V. *Spent.* Testis shrunken, not full and round, little sperm.

Females:
I. *Immature.* Ovaries small and threadlike, eggs microscopic.
II. *Mature unripe*, or *Virgin maturing.* Gonad of moderate size, eggs microscopic, gonad often translucent. The two stages may sometimes be distinguished as there may be remains of corpora lutea in the mature fish visible as small orange flecks in the ovary.
III. *Mature ripening.* Ovary of moderate size, eggs visible to the naked eye, opaque.
IV. *Nearly ripe.* Ovary enlarged and extended, eggs clearly visible, opaque.
V. *Ripe.* Ovary enlarged and distended, tunica breaks easily, some eggs transparent.
VI. *Ripe running.* Nearly all eggs transparent, eggs extrude on slight pressure to flank.
VII. *Spent.* Ovary flaccid, shrunken, and with some residual eggs.

Although stage II males are called mature unripe it seems probable that sperm may be present in the testis before the fish are capable of mating, as in *L. bohar* a very small gonad holding some sperm may be found in fish of about

200 mm. but the first males found with enlarged ripe gonads were of a much greater size than this. State II contains both virgin developing males, and mature males in resting condition. No macroscopic difference was noticed between the two.

Species	*No. Examin.*	*Immature*	*Mature*
Lutjanus bohar (Forskal)	854	443 (150–439 mm.)	411 (440–660 mm.)
Aprion virescens Valenciennes	259	18 (202–452 mm.)	241 (460–800 mm.)
Lutjanus rivulatus (Cuvier)	129	4 (395–449 mm.)	125 (450–640 mm.)
L. fulviflamma (Forskal)	126	41 (51–159 mm.)	85 (160–220 mm.)
L. gibbus (Forskal)	121	10 (170–219 mm.)	111 (220–355 mm.)
L. sanguineus (Cuvier)	102	39 (170–479 mm.)	63 (480–650 mm.)
L. kasmira (Forskal)	77	—	77 (125–205 mm.)
L. sebae (Cuvier)	27	12 (128–489 mm.)	15 (490–665 mm.)
L. monostigma (Cuvier)	18	7 (275–349 mm.)	11 (350–420 mm.)
L. argentimaculatus (Forskal)	13	9 (300–459 mm.)	4 (460–630 mm.)
		Size Range	
Pristipomoides microlepsis Bleeker	12	260–640 mm.	
Lutjanus ehrenbergi (Peters)	6	44–98 mm.	
L. vaigiensis (Quoy and Gaimard)	6	200–250 mm.	
L. lineolatus (Ruppell)	5	120–175 mm.	
Pristipomoides typus (Bleeker)	1	525 mm.	
Aphareus rutilans Cuvier	1	780 mm.	
Lutjanus duodecimlineatus	1	150 mm.	

TABLE I

A list of the Lutjanids taken during the survey, with the proportions of mature to immature fish. (For the commoner species the smallest length at which mature fish were found is used for a division into 'mature' and 'immature' fishes in the table.)

Lutjanus bohar (Forskal)

L. bohar is one of the commonest predators of exposed coral reefs in the East African coastal area. The majority of specimens were taken by handline, but the species was also taken in basket traps, trammel nets, and very occasionally on trolled lures. It is fairly common in local markets, seldom in abundance, but present in regular quantities throughout the year. Wheeler and Ommanney (1953) took larger numbers and a greater total weight of this species than any other on the Mauritius-Seychelles banks.

This species sometimes causes ciguatera poisoning in the Mauritius area and is banned in the markets there. Harry (1953) states that in Raroia Atoll of the Tuamotu Archipelago 'large adults of *L. bohar* are poisonous, and natives know to a few inches of length when an individual is poisonous or not'. Randall (1958) in his review of ciguatera mentions this species as causing poisoning in a number of areas. Whitley (1943) in his list of poisonous fishes of Australia includes the closely allied (perhaps synonymous) *L. coatsi*. In spite of this there is no record known to the author of this species being considered poisonous in the East African coastal region, and both there and in the Seychelles (Wheeler and Ommanney, 1953) *L. bohar* is considered a prime market species. Randall's suggestion that this type of poison enters the fish through one of its foods,

probably a blue-green alga, is consistent with the species being poisonous in some areas and not in others.

Handlining showed this species to be common on exposed areas with actively growing coral in from 4 to 15 fathoms. Adults were seen underwater on the outer slope of the fringing reef, and entering into gaps in the fringing reef where these were deep (five to seven fathoms), but were not seen in areas where the channel was shallower than this, or on the reef flat at high tide, (see figs. 4 and 5). Juveniles of about 100 mm. were seen in and about coral where the fringing reef channel was under 5 fathoms deep. On the outer edge of Tutia Reef and on Latham Bank the species was usually seen in loose and actively moving shoals of about two to seven fish, over coral in mid-water in 3 to 10 fathoms. Underwater observation did not go deeper than this. Shoals were loosely knit, and seemed to break up and rejoin, with no tight cohesion as with many other species of the genus. What shoaling instinct there was, however, results in the species being more often seen in twos and threes than singly. Unlike many related species which may stay around one coral head for the time observed (maximum 2 hours), *L. bohar* is continually on the move, as though actively searching for food over wide areas. Actual feeding has not been observed underwater.

L. bohar was also found to be common in deep water of the Kenya coast in the region of Lamu (see fig. 1). In this area the continental shelf is wider than in most of the East African coastal region, and rich populations of fishes were found on grounds approximately 25 to 65 fathoms deep. *L. bohar* was caught from 25 to 46 fathoms, but where a bathythermograph was used while fishing it was never found below the major thermocline, which varies from 25–50 fathoms with season (Newell, 1957). The dominant species in these rich populations were *Lutjanus bohar*, *Lutjanus rivulatus*, *Epinephelus undulosus*, *Lutjanus sanguineus*, *Lethrinus waigiensis*, and *Lethrinus kallopterus*, in order of abundance (Williams, 1958).

Sampling showed that this species is present on the reefs at all times of year and showed no evidence of migrations. Underwater observations proved that on certain small reefs the species could be present at one visit and not at the next.

Feeding

Of the 854 *L. bohar* examined, 58% of the fish caught had empty stomachs or contained only bait. Table II lists the food organisms found in *L. bohar* stomachs. The species is a euryphagous predator, feeding basically on fish (see fig. 2), but capable of eating crawfish, crab, prawn, squid, octopus, ophiuroids and even pelagic pteropods, doliolids and pyrosomas when these are abundant in the plankton. Although a wide variety of small reef fishes was the main food over the period of study, at certain times when there was an abundance of any one organism the samples contained nothing but these organisms. This was clearly seen in two samples from North Mafia Bay

(Cumulus Bank), and once in a deep-water sample from Lamu. In December 1952 a large proportion of the samples from these two banks was packed with Penaeid prawns, probably migrating to or from the mangrove areas of the huge Rufiji delta. In November 1953 there was an unusually large amount of a larval Stomatopod in the Mafia-Latham Island area. These were seen swimming on the surface at night, and almost everything caught from bottom-dwelling Epinephelids to pelagic Sphyraenids contained them. All *Lutjanus*

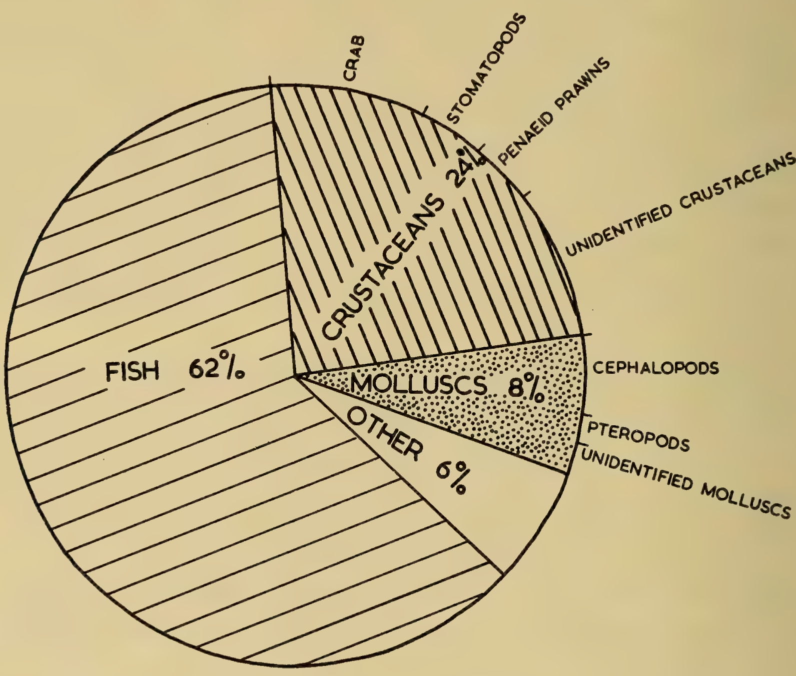

FIG. 2
Relative abundance of food organisms found in *Lutjanus bohar.*

bohar from Vulture, Cumulus and Latham Banks were full of Stomatopod remains. In one particular sample (14–19 November 1956) of the many taken from deep water off Lamu, *L. bohar*, *L. sanguineus*, *L. rivulatus*, *Aprion virescens* and one species of *Ephinephelus* all contained salp tests. Otherwise salps were not a common item of food in any of these species. *L. bohar* then follows the general pattern that most predatory species at any one time will eat the commonest foods available to them in their particular habitats (Stephen 1930, Allee *et al.* 1949).

Some change of diet with size was shown. The smallest *L. bohar* taken (150 mm.) were already fish predators and fish was the predominant food throughout the size range investigated. Crabs were first found in fish over 200 mm. in length, and Cephalopods only in fish over 250 mm. As the fish

increased in size above this Cephalopods became an increasingly important food.

Wheeler (in Wheeler and Ommanney, 1953) found essentially similar feeding for *L. bohar* of the Mauritius-Seychelles banks, although a greater frequency of crustacean and plankton food was found (Fish 114, Crustaceans 117, Plankton 116, Molluscs 83, other 31). Wheeler also concluded that plankton is taken only in times of special density.

Reptilia
- Green Turtle (*Chelone midas* L.) juvenile.

Pisces
- Carangid fish
- *Holocentrus* sp.
- *Ostracion* sp. juvenile
- Echidnid eel.
- Scaridae (many unident. species)
- *Lethrinus chaerorhynchus*
- *Lethrinus latifrons* Ruppell
- Syngnathid fish
- *Canthidermis* sp.
- Monacanthid fish juvenile
- Clupeidae
- Mullidae.

Tunicata
- *Pyrosoma*
- *Doliolid.*

Echinodermata
- Ophiuroids.

Mollusca
- *Cavolinia* sp.
- *Turbo* sp. ('Green Snail')
- Octopus
- Squid
- *Tectibranch* rem.

Crustacea
- *Charybdis natator* (Herbst)
- *Calappa* sp.
- *Charybdis* sp.
- *Lupa sanguinolenta* (Herbst)
- *Achelous* sp.
- *Thalamita* sp.
- *Monomia* sp.
- Xanthid crab
- Oxyrhynchid crab
- *Panulirus* sp.
- *Penaeus* sp.
- *Pagurus* sp.
- *Metapenaeus* sp.
- Scyllarid larva
- Megalopa larvae
- Sphaeromid Isopod
- Amphipods
- Stomatopod
- Stalked cirripede.

Polychaeta
- Polychaete bristles.

Plants
- *Cymodocea* leaves
- Green alga.

TABLE II

Food organisms found in *Lutjanus bohar*.

GROWTH RATE

Wheeler (op. cit.) has estimated the growth rate of *L. bohar* on the Chagos Bank (Seychelles) from length-frequency curves, and has suggested that the one-year group is 180 mm. total length (136 mm. standard length), with additions of 120 mm. and 110 mm. in the second and third years respectively. He estimated that on the Seychelles plateau and the Amirantes 510 mm. total length (425 mm. standard length) was attained in four years. The Peterson method of age determination is dependent on a short spawning period and roughly equal growth rate of the individuals of each spawning. Wheeler found, in over 2,000 fishes taken during 1948–9, that ripe females were present only in October and November and again in March, suggesting that the first of these tenets is satisfied, with due allowance made for the addition of a new group every six months and not every year. As different banks were considered

separately there is every reason to suppose that growth rate is approximately the same and that the method is valid for *L. bohar* in the Seychelles-Mauritius area. In the East African coastal region, however, the breeding season seems to be an extended one, ripe female fish being taken over most of the year. This and the small size of samples has precluded the use of the Peterson method here.

Wide, diffuse rings (formed of a group of fine rings) were present in juveniles, but in adults the scale checks were often sharp, with the lamellae after the check beginning at different angles, as though either resorption had taken place, or growth had begun again after complete cessation. If the checks in the adults are spawning checks, the diffuse rings in the juveniles are possibly due to a physiological sex rhythm already existing in the juvenile, as suggested for the Hake by Hickling (1933).

Peripheral checks were seen in September, November, January, February, March, April, and May. This is mainly in the north-east monsoon period, which lasts from November to April, when the water temperatures are higher than the period of the strong south-east monsoon from May to October. The largest *L. bohar* taken during this survey and aged was 660 mm. standard length, and showed 12 growth rings. On one fish of 615 mm. 13 rings were found. The smallest fish whose scales were read was 200 mm., and showed three growth checks. Increments were 70 mm. and 60 mm. in the fourth and fifth year, and then gradually reduced to approximately 35 mm. per year (see Table III). Maturity was reached about the sixth to seventh year (450 mm.) and no difference in growth rate was seen between the sexes.

Age	*St. Length to nearest 5 mm.*	*Annual Increment*
0–2	?	?
3	240	?
4	310	70
5	370	60
6	420	50
7	465	45
8	510	45
9	550	40
10	585	35
11	620	35

TABLE III

Average lengths and increments for different age groups of *L. bohar*. Maturity reached at 6–7 years.

This is a very much slower growth rate than that given by Wheeler, increments being about half as much from scale ringing. The possibility cannot be excluded that two rings are laid down per year, although at present there seems no obvious reason for such double ringing in the coastal fishes.

MATURITY AND SPAWNING

No distinct spawning periods were found in *L. bohar*. Few ripe (Stage V) females were found, these being taken in July, September, November, February and March. This suggests an extended breeding season over most of the year. The double spawning period suggested by Wheeler (op. cit.) for *L. bohar* in the Seychelles area is not proved for coastal fish by these results. The smallest females with enlarged gonads (recorded as ripe or nearly ripe) were 445 mm. Although sperm was seen in males as small as 270 mm., when the testes are still threadlike, the first ripe (Stage III) males were found at 450 mm.

Aprion virescens Valenciennes

Aprion virescens is a fast-moving predator common over coral areas in 3 to 15 fathoms, feeding from the surface through the mid-water region to the bottom. It is the only Lutianid species to be regularly taken by surface lures. 259 specimens were taken by handline and surface lure from 202 mm. to 800 mm. standard length (25 lb.). This species was often taken when handlining for *L. bohar*, usually on non-weighted lines. Over coral reefs in from 4 to 14

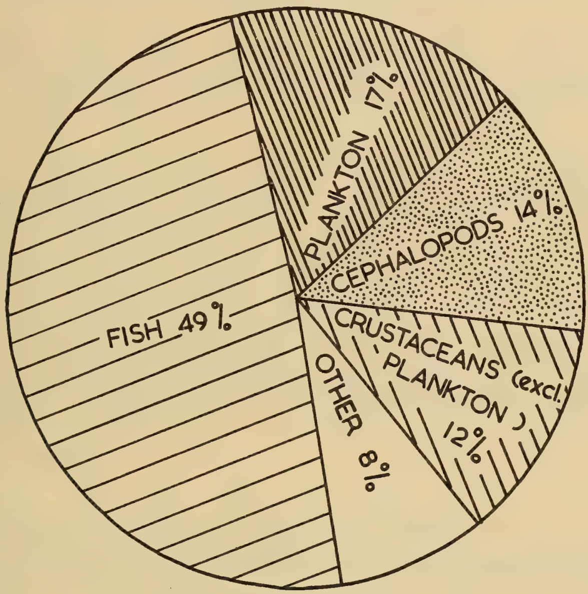

Fig. 3
Relative abundance of food organisms found in *Aprion virescens*.

fathoms *L. bohar* is typically caught from mid-water to the bottom, and *Aprion virescens* from the surface to mid-water. They therefore occupy distinctly different, but overlapping habitats. *A. virescens* has been caught on handlines fishing down to 50 fathoms. The statement by Williams (1956 p. 37) of this species being taken on lines fishing from 75–80 fathoms is an error, and refers to a specimen taken fishing at 50 fathoms off the north end of Pemba Island on 23 October 1953. More than once this species has followed handlines being hauled in from deep water (50–60 fathoms) to the surface. It is possible that the species, which is mainly known as pelagic, may take the bait as the lines are being hauled in, and not at the bottom. There is no proof at present of the species occurring below the major thermocline in the colder sub-surface water.

A. virescens is considered a prime food fish, and occurs in the local markets throughout the year in small numbers.

Underwater, *A. virescens* is commonly seen in coral areas (Mafia, Latham, Cumulus, Zanzibar Channel), always actively moving in mid-water, never

sheltering in coral. It is usually in loose and widely spaced shoals of two to five fish, but occasionally solitary.

Feeding

A. virescens seems able to feed from the surface to the bottom. Fish was the most important food taken, and comprised *Lethrinus microdon*, *Iniistius* sp., Siganids, Tetraodonts, Scarids, Balistids, Labrids, Synodontids and Atherinids. Plankton was also often found in the stomachs of even the largest fishes, and included fish eggs, larval fish, stomatopod larvae, salps and zoeae larvae. Crustaceans, mainly Portunid crabs, and to a lesser extent Penaeid prawns, were also important. Squid was occasionally taken. (See fig. 3.)

Maturity and Spawning

The smallest female recorded as ripe (Stage V) was 465 mm. standard length, and another female of the same length as mature ripening (State IV). Gonads of males were seen with sperm at 410, 420, 455 and 460 mm., but the smallest males recorded with enlarged full testes were just under 500 mm.

Ripe females were found only in December, January and February, suggesting a breeding season during the warmer water of the north-east monsoon period. Nearly ripe fish (Stage IV) were recorded in most months, and more information will probably prove an irregular extended breeding season.

Lutjanus rivulatus (Cuvier)

One hundred and twenty-nine specimens were taken by handline and underwater spearing, ranging from 395–640 mm. (maximum weight of 19 lb.). This species had rarely been taken from the E.A.M.F.R.O. research vessels until the rich fish populations at Lamu off the Kenya coast had been found (mentioned under *L. bohar*) in 25–65 fathoms. *L. rivulatus* formed about 20% of the catch in these areas. Underwater observation has shown that although seldom caught by handline over shallow coral reefs, *L. rivulatus* is common in certain sheltered coral areas such as Tutia Gap (Mafia) and inside the fringing reef in 5–7 fathoms with *L. bohar* on the east coast of Zanzibar Island, and also at Ras Kizimkazi at the southern tip of Zanzibar Island. At these places occasional mid-water shoals of five to ten fish, often in conjunction with *L. bohar* and *L. argentimaculatus* are present. The species has also been seen singly sheltering under dense beds of the 'platform coral' (*Acropora hyacinthus* [Dana]) on Tutia Reef, and in rocky areas at 5 fathoms on Latham Bank.

Feeding

L. rivulatus is predominantly a fish predator, also taking crabs, polychaetes, squid, octopus, echinoids, ascidians and polyzoa. It is chiefly a bottom feeder. One sample from deep water contained many fishes filled with salps.

Maturity and Spawning

Maturity is reached in both males and females at about 450 mm. standard length. Ripe females were found in February, March, April, November and December, and ripe males in March, April, August, November and December, suggesting an extended breeding season in the warm north-east monsoon period.

Lutjanus fulviflamma (Forskal)

This species is abundant over the whole East African coastline extending as far south as South Africa (33°S.), and although small in size is an important species economically, always present in the local fish markets, often in large numbers. It is common in the fringing reef channels, the outer reef slope, mangrove areas, the reefs of Zanzibar channel, the Mafia area and in estuaries (see figs. 4 and 5). Juveniles have been seen in pools on the reef flat, and in shallow water of from six inches to a foot around Zanzibar town over both sandy and weedy bottoms. No other Lutjanid species has as wide a distribution of habitats as *L. fulviflamma*.

One hundred and twenty-six specimens were examined, taken by basket-trap, handlines, trammel-nets, and bought from the local markets. The size range was from 51–220 mm.

Feeding

Crustaceans were the predominant foods; being mainly crabs (including Portunids and Callapids) and also Eupagurids, Sphaeromid isopods, Penaeid prawns and Stomatopods. Fish remains included Engraulids, Fistularids and gobies.

Different samples often contained foods of one type, presumably indicating local abundance of one particular food organism in the area in which the sample was obtained. Most of the food organisms found were bottom animals.

The investigation of small samples of this species in Durban Bay (South Africa) by the Zoology Department, University of Cape Town, has shown very similar results. Bottom-dwelling crustaceans (mainly *Hymnosoma orbiculare* Dem. and Penaeid prawns) predominated in the stomachs, with fish (Eleotrids, gobies and *Lutjanus* sp.) next in importance (from unpublished records by courtesy of Professor J. H. Day).

Maturity and Spawning

Of 112 fishes whose gonads were examined, 36 were immature and unsexed, of the remaining 76, 51 were female and 25 male. Of one sample of 13 fish, 12 were female and 1 male. Males were recorded with sperm as small as 145 mm., and the first fully ripe male was found at 170 mm. Ripe females were recorded as small as 160 mm.

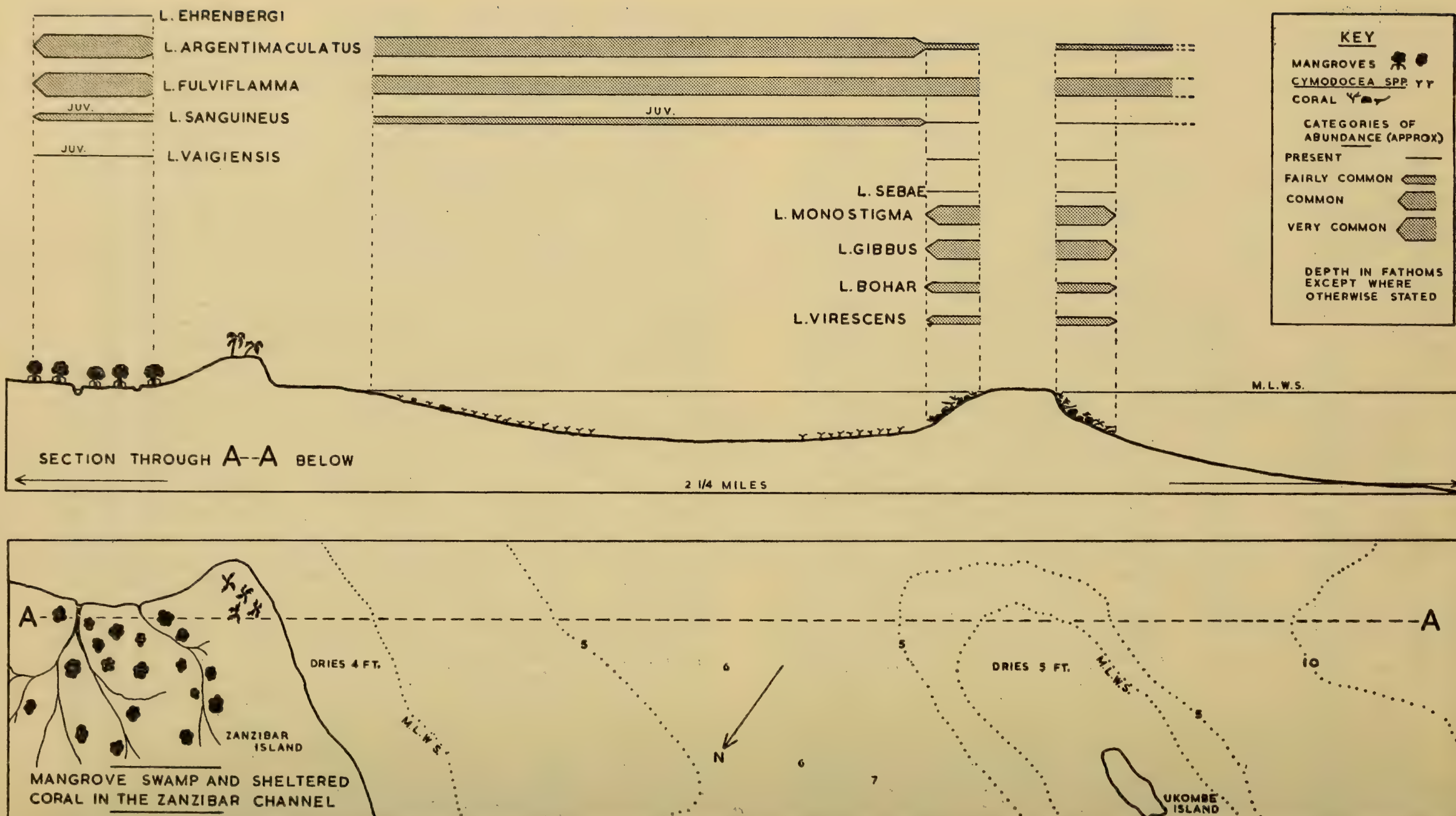

FIG. 4

Distribution of Lutjanids and an indication of relative abundance in mangroves and a coral area not exposed to violent wave action. This example has been taken from the Zanzibar Channel at Ukombe Island Reef. (Based on British Admiralty Chart 665.)

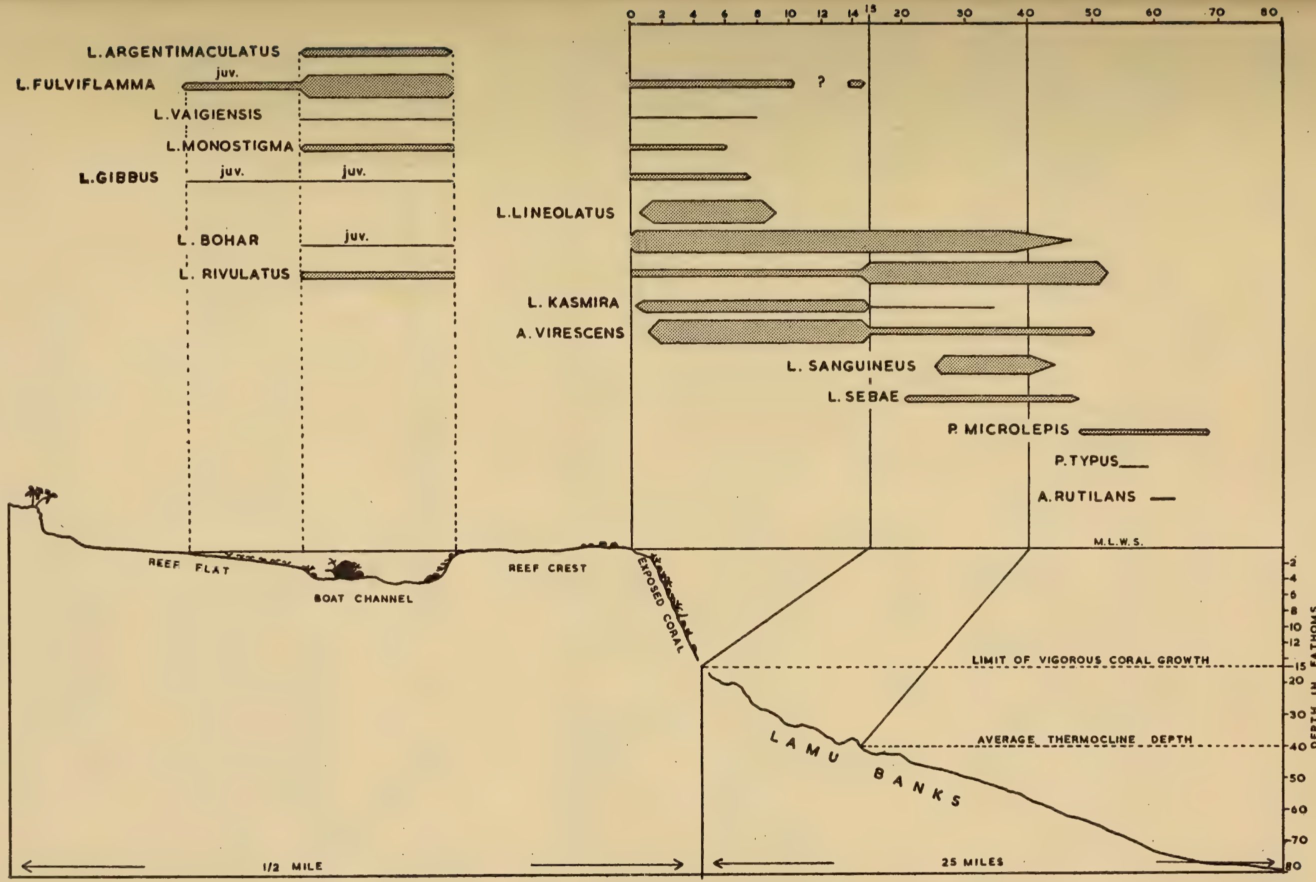

Fig. 5

Distribution of Lutjanids and an indication of relative abundance on a coral reef exposed to the open Indian Ocean, with its sheltered reef flat and boat channel, and the deep-water banks at Lamu. The profile is diagrammatic and based on no single area. An outer reef flat between the reef crest and the boat channel is not included here, as its fish fauna is similar to that of the inner flat. Key as in fig. 4.

Ripe females were found in March, August, October and December, suggesting an extended breeding season mainly in the north-east monsoon period.

Lutjanus gibbus (Forskal)

Lutjanus gibbus is a small species, seldom reaching more than 4 lb. in weight, occasionally seen in local fish markets, but seldom in large numbers.

One hundred and twenty-one specimens were taken by handlining and trammel-nets, always on the bottom and never in mid-water with *L. bohar* and *A. virescens*. The size range of fish taken was from 170 to 355 mm. This species was usually taken at night. It was only found in shallow water of from 3 to 8 fathoms.

Underwater observations showed that this species keeps a few inches above the coral, often sheltering in the branches of 'stag coral' (*Acropora formosa* [Dana]), and in the leaves of 'platform coral' (*Acropora hyacinthus* [Dana]). It was seldom seen singly but usually in dense, closely knit shoals, typically roving over the bottom in a single layer, closely following the bottom contours. Numbers ranging from one to fifty fish and over were seen, but usually shoals were from ten to twenty-five. The species is common on exposed and sheltered coral reefs with rich coral growth, and was seen at Tutia, Vulture, and Cumulus banks in the Mafia area, and on the fringing reef outer slope at Zanzibar. It was also taken on Latham bank and at Lamu. Adults were never seen in the fringing reef channels. Juveniles of about 50 mm. long were seen on the reef flat, and are occasionally taken in beach seine hauls on Zanzibar Island.

Feeding

Foods eaten were mainly crustaceans, including crabs and Penaeid prawns. Small coral fishes were also occasionally taken. Coral and sand were sometimes present in small quantities.

Maturity and Spawning

The smallest mature females with gonads approaching spawning condition (Stage IV) were found at 223, 235, 240 and 245 mm. standard length. The smallest mature males were 240 and 280 mm. Ripe fishes (either sex) were found in March, November, September and December, i.e. the north-east monsoon period.

Lutjanus sanguineus (Cuvier and Valenciennes)

One hundred and two specimens were taken by handline and basket-trap, ranging from 170–650 mm. (13 lb.). Juveniles were taken in basket-traps in the Zanzibar channel and in the Mafia area, in 6 to 7 fathoms on coral and

Cymodocea bottoms, and were also found in the Chukwani fish-ponds (Zanzibar Island), a mangrove area. Adults were not taken by basket-trap, or by hand-lining in daylight over coral reefs. On one bank in the Mafia area (Snapper Knoll, Niororo Island) adults were taken on four occasions by handlining at night. Adults and juveniles were also taken by trammel-nets overnight in shallow water in Lamu Harbour. Adults of *L. sanguineus* were common in 25–47 fathoms off Lamu, and were one of the dominant species in these deep-water catches (mentioned on p. 555).

At certain times of year (January, February and March) this species occasionally floods local markets (Zanzibar Island), being taken off the southern tip of Zanzibar Island in 40 fathoms. Off Shimoni (Kenya) it is also taken in quantity at certain times of the north-east monsoon (November to April). *L. sanguineus* was never observed underwater.

When it is caught it is seldom taken singly, but usually a number within a few minutes suggesting a shoaling habit.

Feeding

Fishes were the commonest food (including *Syngnathus biaculeatus*, Monacanthids and Apogonids) but Penaeid prawns, crabs, stomatopods, cephalopods and plankton (salps, doliolids, pteropods and medusae) were also found. No change in diet with size was found.

Maturity and Spawning

The smallest males and females with ripe gonads were 480 mm. and 505 mm. respectively. Stage IV females were found in March, August, September and November and Stage V females in April and August. Stage III males were found in March, April, August and November.

Lutjanus kasmira (Forskal)

Seventy-seven specimens were caught by trammel-net, underwater spearing, and handline, ranging from 125–205 mm. *L. kasmira* is a small species seldom reaching ¾ lb. in weight, and is not caught unless very fine lines and hooks are used.

Underwater it is seen to be abundant, often in dense shoals of 25 fish and more, never singly, and usually about actively growing coral in exposed areas. It has been seen off Ras Nungwe (Zanzibar), Tutia Reef, and outside the fringing reef on the Zanzibar east coast, in 2–5 fathoms. One specimen taken in deep water (35 fathoms) off Malindi (Kenya) differs slightly in coloration, scaling, and the number of dorsal spines from the shallow water specimens, and is probably a deep water race. This specimen has been described in a previous communication (Talbot, 1957). The species is not found in sheltered mangrove areas, and has not been seen about the Zanzibar channel reefs. It is occasionally seen in local markets.

Feeding

Crustaceans were the predominant food and included crabs and amphipods. Squid, fish remains and algae were also found.

Maturity and Spawning

Females were mature at the smallest sizes taken, i.e. 125 mm. Males were first seen with sperm at 155 mm., and first recorded as ripe at 165 mm.

Ripe fishes were found in March and November suggesting breeding in the warm water north-east monsoon period.

Lutjanus sebae (Cuvier)

Twenty-seven specimens were taken by handlines (adults), basket-traps and spear-guns (immature fish), ranging from 128 to 665 mm.

The juveniles of this species occur in shallow water (5–10 fathoms) and fish up to 360 mm. (3½ lb.) have been taken on banks in the Mafia archipelago (Snapper Knoll near Niororo Island and Sefo Reef). Larger specimens have been found to be fairly common in deeper water of 20–48 fathoms and were taken off Tutia Reef and on the Lanu Banks. Occasional specimens of up to 60 lb. have been seen at Ras Kizimkazi (Zanzibar Island) taken on handlines in 40 fathoms by local fishermen. *L. sebae* occurs regularly in small quantities in Zanzibar markets. It was never seen underwater by the author but has been seen in 5 fathoms on Sefo Reef by Dr. J. F. C. Morgans (personal communication).

Feeding

Stomachs contained fish, stomatopods, crab and cephalopod remains.

Maturity and Spawning

Females with developed gonads (Stages IV and V) were only found above 490 mm. standard length. Insufficient data were obtained to estimate size at which males mature. Breeding is in the north-east monsoon period, ripe fish having been found from November to March.

Lutjanus monostigma (Cuvier)

Eighteen specimens were taken, 15 by underwater fishing and 3 by handlining in 1–4 fathoms. Size range was from 275 to 420 mm. This species is very rare in the local markets. Underwater observation, however, showed it to be common in areas where large coral growths form deep shelter, and it seems completely limited to this type of habitat. It was common about Tutia Reef, Latham Island, in the Zanzibar Channel, and was seen occasionally inside the fringing reef on the Zanzibar east coast. It was never seen in shoals although

two or three were often seen under one coral shelter. Individuals often remained under one coral for the whole period of observation (up to two hours).

Feeding

Fish remains (including one Mullid and one Labrid) were present in most stomachs, and Penaeid prawn remains were also found.

Maturity and Spawning

Ripe or nearly ripe females (Stages IV–V) of 395 mm., 390 mm., 420 mm., and 400 mm. were taken. No ripe males were caught. From the meagre data the fish appear to mature at over 350 mm. (2 lb.).

Ripe females were found in November and February.

Lutjanus argentimaculatus (Forskal)

Thirteen specimens of 300 to 630 mm. ($15\frac{1}{2}$ lb.) were taken from sheltered reef areas in up to 7 fathoms by handlining or set nets at night. This species is abundant in East African coastal waters, and is an important market species. It does not occur on exposed coral reefs, however, and is therefore not well represented in the E.A.M.F.R.O. catches. It is very common in shallow mangrove areas and estuaries, and common in sheltered waters such as the Zanzibar channel. It was commonly seen during underwater observation inside the fringing reef off the Zanzibar east coast, in the semi-estuarine waters of Chwaka creek (Zanzibar) and about large, and often dead, coral growths in the Zanzibar channel. It may occur singly or in shoals of up to 20 fish. Juveniles are fairly common in sheltered mangrove areas.

L. argentimaculatus was never seen during underwater observation on exposed coral reefs.

Maturity and Spawning

Males were found with testes containing sperm at 330 mm., 410 mm. and 460 mm., and one ripe male of 515 mm. was taken in November 1958. One female was considered mature at 460 mm., and one ripe female of 630 mm. was taken in November 1957.

Lutjanus ehrenbergi (Peters)

Six specimens were taken from mangrove pools on Zanzibar Island (Chukwani fish-ponds) from 44 to 98 mm. standard length. Two of the specimens were fully mature females of 75 mm. These are the smallest mature *Lutjanids* found during the survey. *L. fulviflamma*, also maturing at a relatively small size, was first found mature at 150 mm. *L. ehrenbergi* was never seen during underwater observation.

Lutjanus lineolatus (Ruppell)

Five individuals of this small species were taken (standard lengths 120–175 mm.) but no biological data were obtained from them. Underwater observation showed this species to be often present in large shoals (30 to over 100 fishes) on exposed coral reefs, often in conjunction with *L. kasmira*. It is also fairly common in East African markets, and its rarity in E.A.M.F.R.O. catches are due to catching methods.

Lutjanus vaigiensis (Quoy and Gaimard)

Six specimens were taken by underwater spearing and handlines from 200 to 250 mm.

This small species has very occasionally been seen in local markets, and underwater observations shows that it is present, although not common, on shallow coral reefs (Ras Nungwe, Tutia Reef, inside the Zanzibar fringing reef), usually singly, but occasionally in pairs. It is always in or near coral shelter. It is often present in the same areas as *L. monostigma*. Shoaling in this species has never been seen. Juveniles have been taken in a mangrove area (Chukwani fish ponds, Zanzibar Island). Fully mature males were found at 190 and 205 mm.

Pristipomoides microlepis (Bleeker)

Twelve specimens were obtained by deep lining (47–67 fathoms) ranging from 260 to 645 mm. (14 lb.).

This species has been taken off Malindi, Pemba, and Tutia Reef. Smith (1954) records it as a major component of the Shimoni (Kenya) deep-water fishery. The species lives in the cold sub-surface water below the thermocline, and has not been taken in shallow water.

Pristipomoides typus (Bleeker)

One specimen of 525 mm. (8½ lb.) was taken off Tutia Reef in deep water (about 55 fathoms). Smith (1954) records it as occurring in the deep-water Shimoni fishery.

Aphareus rutilans Cuvier

One specimen, a mature female of 785 mm., was taken at 60 fathoms off Lamu. Water temperature at that depth was 19°C. from a bathythermograph reading.

Lutjanus duodecimlineatus (Valenciennes)

One specimen was purchased in the Zanzibar fish market (150 mm.).

Conclusion

Few *Lutjanids* are restricted to the East African coast. Of the seventeen species recorded here, all except two (*L. ehrenbergi* and *L. duodecimlineatus*) reach the Australo-Pacific region. In the reverse direction distribution of this family is not so uniform, however. Many Lutjanids found in the Parific Ocean and the Eastern Indian Ocean are not found in the Western Indian Ocean. For example, in the genus *Lutjanus* 32 species occur in the Hawaiian Islands (Herre, 1953), excluding the freshwater *L. maxweberi* and the doubtful *L. philippinus*. Of these only 13 are found in East Africa. This suggests a centre of origin, or at least strong adaptive radiation in the Australo-Pacific region. At present there is clearly difficulty of dispersal in an east-west direction for many species, but whether this is due to paucity of suitable environments in the north and western Indian Ocean, or to some physical barrier to migration is not obvious. Temperature, which limits the southerly distribution of this typically warm-water family down the coast of Africa, does not operate as a barrier to its spread along the Indian and Iran coasts. Lutjanid distribution bears out Ekman's statement that 'the rich Indo-Malayan fauna is distributed over a large part of the Indian Ocean, but the number of species constantly decreases as we proceed in a westerly direction'.

Down the African coast some species disappear at Delagoa Bay (26°S.), with the last coral reefs, and then there is a steady decrease in species to East London (33°S.), no members of the genus *Lutjanus*, and only the genera *Aprion* and *Etelis* (Indo-Pacific, not recorded during this survey) reaching farther south, to Knysna (34° 5′S.). (Note: Two specimens of *L. sanguineus* have been taken in Algoa Bay, and one at Plettenberg Bay, 34°S., during 1958–9.) The distribution of this family is paralleled by that of the reef-building corals. Although no coral reef growths have been found south of Delagoa Bay, reef-building genera are found to just north of East London (Stephenson, 1947). Coastal temperatures drop rapidly between Port St. Johns (31° 40′S.) and East London (33°S.) due to an outward turning of the Agulhas current. The latter port coincides with the 20°C. isotherm in winter (Sverdrup *et al.*, 1942).

Vertical distribution is very limited in most of the family (see fig. 4). Of the seventeen species taken eight species were never caught deeper than 14 fathoms. Of these most were common about coral reefs, and their deepest limits coincided with the limit of vigorous coral growth, which was usually between 10 and 15 fathoms. It is possible that the same factors might be the cause of both the limit of distribution of the fishes and the end of reef growth, but more likely that the fishes are limited to the coral habitat.

The thermocline, varying from 25–50 fathoms, is deeper than the foot of the actively growing coral area, and at 10–15 fathoms water conditions differ little from the surface. Temperatures at this depth were not found below 24°C. by Newell (1957) and in summer are very much above this, so temperature does not seem to be a barrier in this connection. Suggested reasons for the downward limit of coral growth will be discussed in a later paper; here it will

be sufficient to state that for *L. vaigiensis*, *L. monostigma*, *L. lineolatus*, *L. gibbus*, *L. fulviflamma* and the shallow-water form of *L. kasmira* (referred to on p. 565), the foot of the living coral reef (excluding tallus slopes) is the downward limit. Although some physical environmental factor or combination of factors may be the cause of this, the abrupt ending coincident with that of the coral suggests that in a downward direction the fish distribution is determined by the latter. *L. fulviflamma* was not restricted to coral areas but was also abundant in sheltered areas such as mangrove swamp channels and *Cymodocea* beds. *L. argentimaculatus*, also limited to shallow water, was found in more sheltered habitats only, including mangrove areas, the boat channel of fringing reefs, and sheltered coral. *L. ehrenbergi* was taken only in a mangrove swamp.

L. bohar and *L. rivulatus* were for a long period (1951–5) considered to have only a shallow-water distribution, never being taken below about 14 fathoms. In 1956, however, when the deep-water (25–65 fathoms) banks off Lamu, Kenya, were fished it was discovered that these two species were often abundant at much greater depths, reaching 46 and 51 fathoms respectively. In these areas the shelf is unusually wide for the East African coast (considered by Morgans, 1959, to be due to the deposition from an old river delta), and rich feeding-grounds are present. It seems clear that this favourable habitat is the reason for the presence of *L. bohar* and *L. rivulatus* in deeper water.

On these banks the bottom temperature may vary from 22°C. to 29°C. Newell also gives one reading of 18°C. at 50 fathoms. (Newell 1959, Morgans in unpublished E.A.M.F.R.O. reports.) From the foods taken by these members of the genus *Lutjanus* it appears that they are all bottom feeders, and it is probable that temperature becomes an important factor in the distribution of these members of this genus to the colder deeper portions of these banks, if we may judge by their distribution down Africa, referred to above. It is quite clear from the great deal of fishing that has now been done in this area that the genus *Lutjanus* is only found in water of the East African coastal current, and not below the thermocline. No members of this genus have been taken in water below 23°C. where a bathythermograph has been used in conjunction with fishing. In addition to *L. bohar* and *L. rivulatus* this also applies to *L. sebae* and *L. sanguineus* whose adults were common on these banks. In the former only juveniles and young fishes up to 360 mm. were taken in shallow water, and adults in water of 30–49 fathoms. Adults of the latter extended from the shallow water of Lamu Harbour (a mangrove area of 4 fathoms) to 47 fathoms, and were more abundant in deep water. Juveniles of these species were only taken in sheltered water.

In contrast to the genus *Lutjanus* the two species of the genus *Pristipomoides* and *Aphareus rutilans* were taken in 47–67 fathoms and 60 fathoms respectively and never in shallower water. Also found on the Lamu Banks, these species are usually present below the thermocline. *A. furcatus*, not taken during this survey but recorded by Smith (1954) in East Africa, seems to be a shallow-water species, being referred to by Randall (1955) as fairly commonly seen underwater

in shallow coral-rich areas of the Gilbert Islands, and taken on the surface on lures by Schultz (1953) on Bikini Atoll. Smith's record is of one specimen from 20 fathoms off Pemba Island.

The genus *Aprion* has a pelagic habit and a depth range to about 50 fathoms, but is more abundant in shallow water over the reefs.

Clear differences were found between the catches of Lutjanids from coral areas facing the open Indian Ocean and exposed to violent wave action, and those of sheltered coral islands in the 15-mile channel between the African mainland and Zanzibar Island or from the inner Mafia Archipelago (see fig. 1). *L. argentimaculatus* was taken both in the boat channel and also from sheltered coral reefs, but never on the outer exposed reef slope. *L. kasmira*, common on the outer slope, was never taken in sheltered water. Numbers of species common to both types of coral area also differed. *L. bohar* was one of the dominant species of the outer slope, but although present in the more sheltered water it was very much less common. Conversely *L. gibbus* was common and sometimes abundant in sheltered areas, but on the outer slope it was poorly represented in the catches.

The reasons for the patterns of distribution described in the above paragraphs are obviously complex, and not within the scope of this work, but many of the problems here raised could be approached experimentally. Temperature, salinity, light, O_2 concentration and turbidity preferences of the juveniles and adults of different species could be tested with carefully designed aquarium equipment, especially for the smaller species, and would undoubtedly give valuable clues to the reasons for their distribution.

On a typical East African reef the Lutjanids are a major component of the fish fauna. They and the *Serranidae* form in general the bulk of the non-pelagic predators, in contrast to the *Carangidae*, *Scomberomoridae* and *Sphyraenidae*. They differ from the *Serranidae* in that while members of this family are usually often solitary and many are more or less stationary for long periods most Lutjanids tend to school and move actively over the coral. The commonest line-caught fish over exposed coral was the large, mainly fish-eating, *L. bohar*, with *A. virescens* common in mid-water and at the surface in the same areas. The commonest smaller species, *L. fulviflamma*, *L. kasmira* and *L. lineolatus*, are often present in shoals numbering 50 and more. These species swim close to the coral and are predominantly crustacean feeders. On sandy bottoms and *Cymodocea* beds their place is taken by the *Lethrinidae*.

In the deeper Lamu Banks off the Kenya coast this family forms the bulk of the predators, if we may judge by the quantities of line-caught fish. Lutjanids, mainly *L. bohar*, *L. rivulatus*, and *L. sanguineus* formed 54% of the fishes taken, the *Serranidae* 26% and the *Lethrinidae* 15%, with 5% of sharks and other species (Williams, 1958).

No sharply marked breeding seasons were found in any of the species studied, although sometimes a single sample would contain many ripe fishes of both sexes. In general all species seemed to breed over a large part of the year, but mostly in the warm north-east monsoon period.

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Summary

Seventeen species of the family Lutjanidae from the East African coast are discussed, and notes on their distribution, feeding, spawning seasons and shoaling habits are presented.

Eight species of the genus *Lutjanus* were found only in shallow water, and were never found below the limit of active coral reef growth (approximately 15 fathoms). The major thermocline at from 25–50 fathoms is suggested to be a barrier to deeper distribution of the five species (four of the genus *Lutjanus* and *Aprion virescens*) found from shallow water to below the living coral reefs. Three species (two of the genus *Pristipomoides* and *Aphareus rutilans*) were found only in deeper water, and never above the major thermocline.

No evidence of migrations was found.

Sheltered coral, and coral exposed to violent wave action were found to differ in the presence or absence of some species of the family, and also in the numbers of species common to both habitats.

All the species studied were euryphagous predators. Details of feeding are given.

No sharply defined breeding seasons were found, but the extended periods in which breeding took place were mostly in the warm months, November to April.

Regular growth rings were found on the scales of *Lutjanus bohar*. Checks were formed at different times of year in different fishes. It is suggested that these are related to spawning. Growth increments of from 70 mm. (3rd–4th year) to 35 mm. (10th – 11th year) were estimated.

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A new Solifugid Arachnid from Table Mountain, Cape. Solpuga grindleyi, *sp.n.* By A. C. Brown. (With 2 figures in the text.)

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A NEW SOLIFUGID ARACHNID FROM TABLE MOUNTAIN, CAPE.

SOLPUGA GRINDLEYI, SP. N.

By A. C. Brown

Zoology Department, University of Cape Town

Though the Solifugae constitute but a small order of the Arachnida, the group is extremely well represented in the South African region, 196 species being now recorded from the area. In particular southern Africa abounds with species of the family Solpugidae; notably the genera *Solpuga* and *Solpugema*, which account for no less than sixty-five of the South African species. It is no surprise, therefore, to find that a new species of Solifugid, recently taken on Table Mountain, in the Cape Peninsula, also belongs to the genus *Solpuga*.

In contrast to the rest of South Africa, Solifugae are rare in the Cape Peninsula and only five species, excluding the new one, are recorded from the area. They are *Solpuga fusca* Koch (1842), *Solpuga monteiroi* Pocock (1895), *Solpugema vincta* (Koch, 1842), *Blossiola litoralis* (Purcell, 1899) and *Toreus capensis* Purcell (1899). The new species, *Solpuga grindleyi*, is quite easily distinguishable from each of these, not only in the laboratory but also in the field. In size and in general appearance it is similar to *Solpuga fusca*, but whereas the latter is a black-legged species, in *S. grindleyi* the legs are coloured yellow-ochre. The species is very much smaller than *Solpuga monteiroi* and the head-plate is light yellow-ochre whereas in the latter species the cephalic plate is very dark and may be almost black. The new species also lacks the median black abdominal band of *Solpugema vincta*.

Examination of the chelicerae (mandibles) of both male and female shows *Solpuga grindleyi* to be distinct from any other species of the genus so far recorded from southern Africa. The dentition of both the upper and lower jaws—not only the position of the teeth but also their number—at once separates it from all the other Cape species including *S. ferox* Pocock (1895), *S. schlecteri* Purcell (1899) and *S. bovicornis* Lawrence (1929) as well as the species already mentioned.

The new species closely resembles *Solpuga fusca* but is distinct from that species not only in coloration and in the dentition of the mandibles, but also with regard to the flagellum of the male, that of *S. fusca* being *bifurcate* while in the new species the flagellar apex is entire.

The author has two specimens of *Solpuga grindleyi* in his possession. A male specimen bearing the label 'Solifugid—Table Mountain' was discovered among the class-material used in the Zoology Department for teaching purposes, while

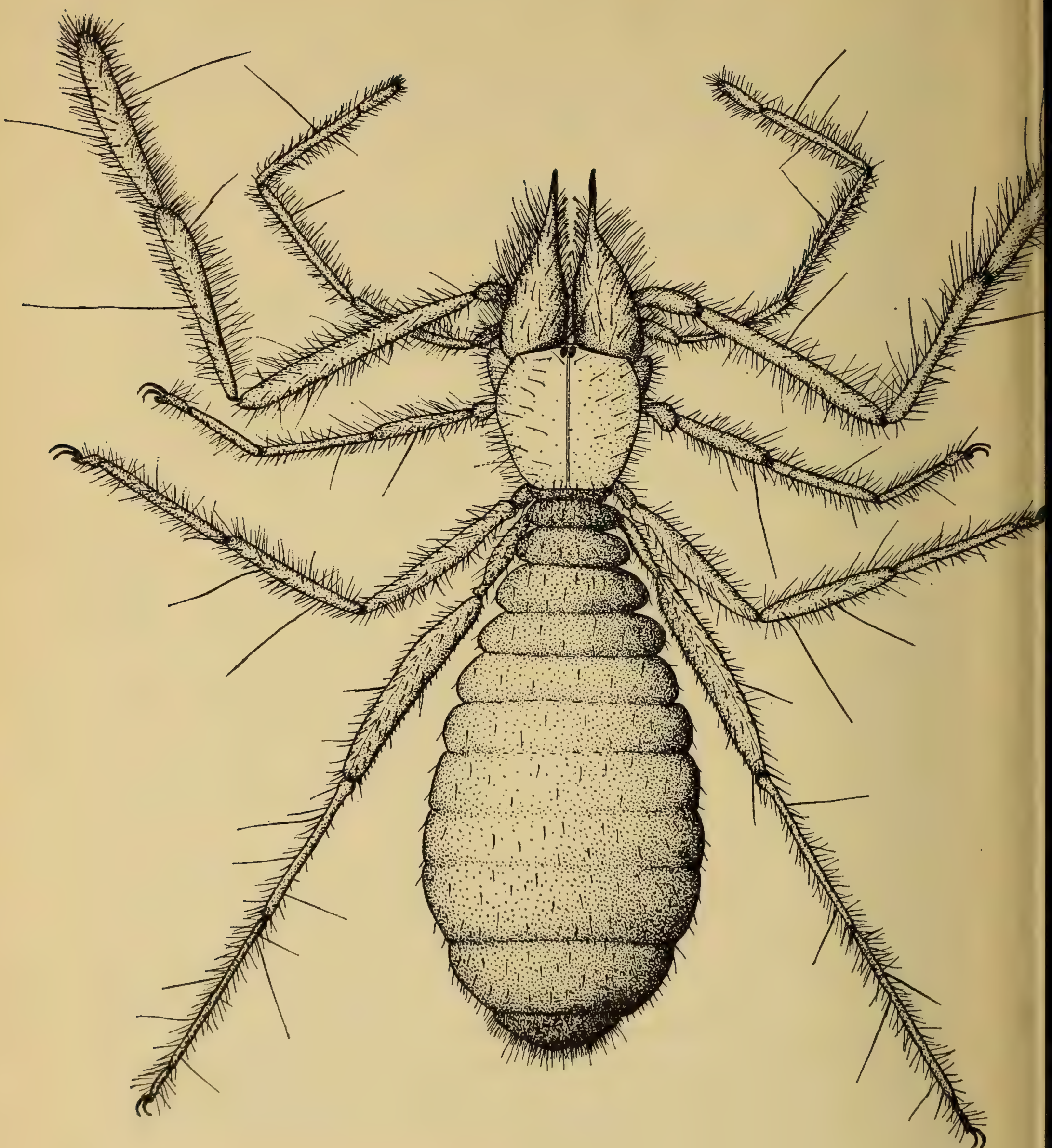

Fig. 1

Solpuga Grindleyi, sp. n. Holotype (♀) × 10.

an adult female was taken complete with nest on the Camps Bay side of Table Mountain by Mr. J. Grindley on 20 June 1958. As the female specimen was studied alive and as the male, though well preserved, does not bear an adequate label, it has been decided to designate the female as Holotype for the new species. The male therefore becomes the Allotype.

Solpuga grindleyi sp. n.

Description of Holotype (Female)

Living coloration. Head-plate yellow-ochre with jet-black eyes; chelicerae light yellow-ochre over most of their surface but giving way to dark brown towards their tips. Abdomen dull grey at the sides and between segments, tergites greyish brown; uniformly light grey ventrally. Ventral surface of thorax light yellow, malleoli yellow with dark brown distal margins. Legs for the most part yellow-ochre, tending towards pale yellow on the tibiae and tarsi of the first three pairs. Pedipalps dark yellow-ochre. Setae in general agreeing with the colour of that part of the body on which they occur, but setae on the chelicerae dark brown against their light yellow-ochre background.

Apparent proportions. Cephalic plate as broad as long, slightly shorter than chelicerae. Abdomen approximately four times length of cephalic plate and twice as broad, evenly rounded. Palp with both tibia and tarsus club-shaped; setae on pedipalps not arranged in a definite pattern, but several very long setae on each of the last three segments. First pair of walking-legs slender, two-thirds length of palp. Second walking-leg somewhat more robust but shorter than first leg. Third leg stouter than both preceding appendages and equal in length to first leg. Fourth pair of legs slender except for expanded femur, longer than all other appendages, including the pedipalp.

Measurements. Total length, 12·4 mm.; greatest (abdominal) width, 3·5 mm. Length of chelicerae, 2·4 mm.; length of head-plate, 2·0 mm.; greatest width of head-plate, 2·0 mm. Length of pedipalp, 9·2 mm.; femur, 3·0 mm.; tibia, 2·5 mm.; tarsus, 2·6 mm. Length of first walking-leg, 6·6 mm.; second leg, 5·0 mm.; third leg, 6·8 mm. Length of last leg, 9·8 mm.; femur, 3·0 mm.; tibia, 2·6 mm.; tarsus plus metatarsus, 3·2 mm.

Remarks. The Holotype was taken alive from under a small stone, complete with nest. The latter consisted of a shallow depression lined with soft chips of wood and a few small pieces of bark. The specimen was kept with part of its nest in a glass tube for some weeks without feeding. It was then given a number of small beetle larvae, which it readily devoured. Vision is apparently poor, as the animal was not disturbed by movements 15 cm. away from it, except when these movements cast a shadow over it. In the latter case, and when a finger was moved to within 5 cm. of the animal, it reared up into

the defence attitude common among the Solifugae. The entire body is raised from the ground, the back legs being bent so that the body acquires an angle of some 30° from the horizontal, the pedipalps are elevated and held far apart, the first pair of legs is lifted from the ground and pointed forwards and the chelicerae are held agape. The animal orientates itself so as to face continually the source of potential danger.

THE MALE SPECIMEN (Allotype)

Colours similar to but somewhat darker than those of the female. Legs and pedipalps tending towards light brown on tibiae and tarsi of all appendages

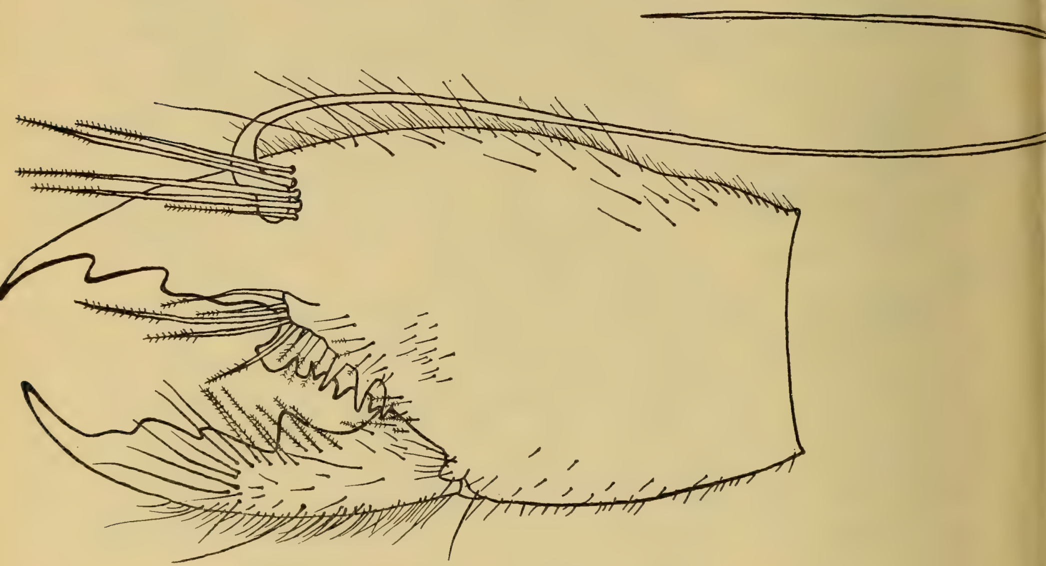

FIG. 2
Solpuga Grindleyi sp. n. Male Chelicera × 40.

and also on the femur of the hind-most leg, though darkish yellow-ochre still predominates. Proportions of parts as for female except that the abdomen is slightly narrower; total body length, 13·6 mm. Body and appendages more setose than in Holotype and the setae themselves very much darker, varying from light brown on the legs to very dark brown on the head-plate and abdomen.

Male chelicera as shown in figure 2. Flagellum very long and slender, being approximately twice the length of the chelicera itself; flagellar shaft tapering evenly, without spicules or denticles. Ventral jaw with a large blunt tooth proximally, followed by two less prominent rounded processes; a convex surface leads to the curved and tapered fang. Dorsal jaw with two large rounded teeth preceding the fang-tip. Between the proximal tooth and the articulation

of the lower jaw occurs, after a short adentate region, a double row of proceses between which the lower jaw fits when at rest. The inner row of processes consists of a flat-topped projection distally to which are attached four stout elongate plumose setae pointing forwards, followed by three sharp spines. The outer row projects somewhat lower than the inner row and consists of two naked flat-topped processes, the first (distal) process being much larger than the second, followed by three sharp spines. Five extremely long, stout, plumose setae are attached immediately behind the base of the flagellum and lie over it, pointing forwards. The distal halves of both jaws are without setae but the proximal part of the lower jaw is quite heavily setose, the setae on the ventral side being simple, those towards the upper surface plumose.

Both types have been deposited in the South African Museum.

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